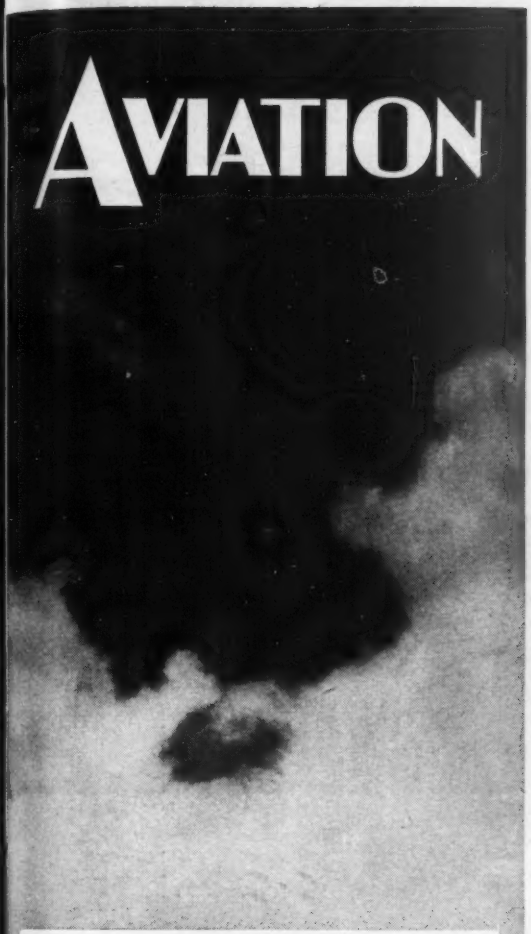
AVIATION



August, 1943

Volume 42 • Number 8

CONTENTS

Briefing for August 5

Down the Years in Aviation's Log 5

Editorial: Calling the Tally On the Truman Report 111

Aviation's War Communique No. 20 112

Bombing—The American Way, I ..... *E. Eugene Miller* 114

Our Planes and Our Peace ..... *Harry Woodhead* 122

Pre-Flight Toughens 'Em 124

Are You Prepared for Contract Termination? ..... *Raymond L. Hoadley* 126

Needed—A Plant Re-Conversion Cost Policy ..... *H. L. Federman* 127

Aviation Manufacturing

Production—Design—Research—Engineering, Complete Index 129

Design Analysis of the Curtiss *Commando* ..... *John Foster, Jr.* 130

Super-Aluminum Alloys for Aircraft Structures, I ..... *Kenneth R. Jackman* 154

Cutting Costs on Perforating Dies ..... *E. H. Ruder* 165

Ring Design Makes or Breaks the Engine ..... *D. M. Smith and Nelson Wainwright* 171

A More Efficient Grinder for Carbide Tools 178

Bell Machine Gun Adapter Raises the Score 178

Fleetwings Wing Chord Divider Beam 181

Aluminum Castings Saved from Scrap 181

Sheet Spring Fasteners Speed Aircraft Assembly ..... *Harm White* 183

AVIATION's Sketch Book of Design Detail 187

AVIATION's Engineering Data Book 193

Review of Patents ..... *A. Harry Crowell* 196

Subcontractor's Section 203

New Products and Practices 233

Air Transport

Cruise Control for Flying Efficiency, II ..... *R. Dixon Speas, Jere T. Farah, and Sanford Hinton* 207

Maintenance

New Planes for Old 215

Maintenance Shorts 216

AVIATION's Maintenance Notebook 219

Military

British Bomber Conversion 227

Military Shorts 229

Civil Operation and Training

When is a Pilot Legally Liable? ..... *Leo T. Parker* 231

Side Slips 201

The Aviation News

National Aviation 271

Washington Windsock 273

Calling Names 274

Aviation Manufacturing 277

Transport Aviation 281

Aviation Abroad 283

Financial Notes 285

Aviation People 286

Book Reviews 287

George W. Pfeil ..... *Publisher*
Leslie E. Neville ..... *Editor*
E. Eugene Miller ..... *Managing Editor*
John Foster, Jr. ..... *Associate Editor*
Herb Powell ..... *News Editor*
David Baker ..... *Assistant Editor*
Dallas Mallard ..... *Art Director*
Wm. R. Nelson ..... *West Coast Editor*
Blaine Stubblefield ..... *Washington Editor*
Paul Wooton ..... *Chief of Washington Bureau*
Raymond Hoadley ..... *Financial Editor*

★ ★ ★

On Leave of Absence With Government Services

Carl Norcross ..... *Lt. Colonel, Air Forces*
Jay P. AuWerter ..... *Captain, Air Forces*
Charles F. McReynolds ..... *Captain, Air Forces*
Randolph Hawthorne ..... *Lieut., Air Forces*
Kenneth D. Reynolds ..... *Lieut., Infantry*
Don Fink ..... *Special Assignment*
Selig Altschul ..... *Special Assignment*

★ ★ ★

District Managers: New York and Boston, Robert F. Boger; Philadelphia, G. A. Ahrens; Cleveland, A. H. Bartsch; Detroit, C. W. Evaul; Chicago, A. B. Martin; Los Angeles, R. N. Phelan; San Francisco, John Otterson

McGRAW-HILL PUBLISHING CO., INC. Publication office 99-129 North Broadway, Albany, N. Y. **Return postage guaranteed. Editorial and executive offices, 330 West 42nd Street, New York, N. Y.** Branch offices: Chicago, 520 North Michigan Ave.; San Francisco, 68 Post Street; Aldwych House, Aldwych, London, W.C. 2; National Press Bldg., Washington; 6 South Broad St., Philadelphia; Hanna Bldg., Cleveland; 2-144 General Motors Bldg., Detroit; Paul Brown Bldg., St. Louis; 1427 Statler Bldg., Boston; Rhodes-Haverty Bldg., Atlanta; 601 W. 57 St., Los Angeles. JAMES H. McGRAW, Founder and Honorary Chairman; JAMES H. McGRAW, Jr., President; HOWARD EHRLICH, Executive Vice-President; MASON BRITTON, Vice-President; CURTIS W. McGRAW, Treasurer; JOSEPH A. GERARDI, Secretary; J. E. BLACKBURN, Jr., Director of Circulation. Aviation, 330 W. 42nd Street, New York. Published monthly, price 50c a copy, 50c in Canada. Allow at least ten days for change of address. All communications about subscriptions should be addressed to Director of Circulation, 330 West 42nd Street, New York. Subscription rates—United States, Mexico and Central American Countries, $3.00 a year, $4.00 for two years, $5.00 for three years. Canada, $3.50 for one year, $5.00 for two years, $6.00 for three years, payable in Canadian currency at par. Great Britain and British Possessions 30 shillings per year, 60 shillings for three years. All other countries $5.00 a year, $10.00 for three years. Entered as second-class matter September 3, 1936, at the Post Office, Albany, New York, under the Act of March 3, 1879. Volume 42, Number 8. Printed in U. S. A. Cable address: "McGrawhill New York." Member A.B.C.

Copyright 1943, by McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York, N. Y. The contents of this issue are copyrighted and may not be reproduced without the permission of the copyright owner. The following publications are combined with AVIATION: AERONAUTICAL ENGINEERING AIRCRAFT JOURNAL, and THE AVIATION NEWS. All rights to above names are reserved by the McGraw-Hill Publishing Co.

Aviation is indexed in Guide to Periodical Literature and in Industrial Arts Index.

MASSIVE STABILITY

for microscopic precision

A hair-breadth error in calibrating a Drift Meter may well put a long-range bomber many miles off course. Hence the use by Pioneer of a *virtually vibrationless* Calibration Stand, supported by pillars of old "settled" steel. In this massive stand, technicians align the image of the gyro-stabilized reticle with the objective image. Sighting through a series of angular and vertical collimators, they calibrate at successive angles ranging from 15° aft to 85° forward.

The elaborate care exercised in calibrating the Pioneer* Drift Meter typifies the production techniques which, with superior design, underlie the *precision performance* of Pioneer Instruments.

ECLIPSE-PIONEER DIVISION

THE PIONEER DRIFT METER

provides a scale reading of the angle between heading and track of plane. It is an important member of "The Invisible Crew" of precision equipment which 25 Bendix plants from coast to coast are speeding to our fighting crews on world battle fronts.

PIONEER INSTRUMENTS

THE INVISIBLE CREW

Precision Equipment by Bendix AVIATION CORPORATION

*TRADE MARK OF BENDIX AVIATION CORPORATION

Briefing for August

Kenneth R. Jackman, chief test engineer for Consolidated Vultee, San Diego Div., has written an important series of articles on "Super-Aluminum Alloys for Aircraft Structures," and featured is first-class design information containing invaluable data on weight saving techniques. His initial installment, covering the new subject of artifically aging 24ST aluminum alloy, begins on page 154.

EARLY THIS SUMMER, when all signs pointed to the coming greatest aerial offensive of all time, there was considerable verbal "rhubarb" concerning the value of bombing in general, and area-versus-precision bombing in particular. European powers had failed in their day-bombing ventures, and this example was used to exert pressure on the Army Air Forces to abandon its precision bombing program. Perhaps the most outspoken were the British press and certain American correspondents who went so far as to urge stoppage of American heavy bomber production in favor of British types. Despite this pressure, the AAF went ahead and demonstrated a mass of power that made all criticism look silly.

AVIATION'S editors felt that none of the discussions really got down to fundamentals and that its readers should have sufficient background information to really appreciate the meaning of **Bombing—The American Way.** Gene Miller flew to Orlando in a *Flying Fortress* and spent some time at the Army Air Forces School of Applied Tactics. Since then he has put in many hours of study and discussion with the AAF's leading bombardment tacticians. Convinced that any discussion of tactical employment would be valueless without probing into the philosophy of bombing and making a thorough appraisal of tactical equipment, Managing Editor Miller confines himself to this end and arrives at a number of salient conclusions in his article on page 114.

CONTINUING AVIATION'S series of comprehensive **Design Analyses,** Associate Editor John Foster, Jr., elected the sensationally efficient Curtiss-Wright *Commando* transport for a thorough breakdown this month (page 130). In 24 uninterrupted pages, Editor Foster supports this first detailed description of the how's and why's of the *Commando* design with 53 sketches and photographs, plus numerous tables of dimensions balance factors, weights, etc.

THE BOMBING ARTICLE, previously mentioned, stresses the importance of crew training, the sole job of the Flying Training Command. Also beginning this month, with a foreword by Maj. Gen. Barton K. Yount, commandant of the newly combined TTC and FTC, is a series on **Building the American Air Forces,** covering every phase of training America's fighting flyers. The first article appears on page 124.

STEP BY STEP construction of a new type of inexpensive perforating die, which is highly efficient and accurate in simultaneous punching of multiple hole patterns of any size or combination, is described on page 165.

CONTROL OF BLOWBY and oil consumption is largely a matter of piston ring design. A discussion of these factors, based on exhaustive test runs, leads to some definite conclusions for both low and high output engines. Page 171.

IN THE SECOND of the series on **Cruise Control for Flying Efficiency,** appearing in the Transport section on page 207, detailed consideration is given to atmospheric variables as they influence airplane performance.

New Planes for Old, on page 215, is a description of a large Canadian manufacturer's set-up for complete repair and overhaul of military training aircraft used in the Dominion.

PRIVATE FLYERS have more than their share of laws and regulations to comply with—in war as well as peacetime. Specific as well as broad interpretations of the law with respect to pilot liability will be found on page 237.

Down the Years

In AVIATION'S Log

25 Years Ago (1918)—"The government is coming to the assistance of war contractors on aircraft manufacture by enabling them to retain the services of skilled workmen who may have been drafted or who enlisted." Indefinite furloughs are the vehicle . . . Otto Praeger issues first report on airmail costs, but leaves out depreciation due to lack of "convincing data"; AVIATION asks reader assistance in presenting cost data in "possibly more accurate manner" . . . Metals show "least encouraging results" as propeller material; failures during test proved "extremely sudden and disastrous to the plane structure" . . . War Sec. Baker reports 450 American-built warplanes sent abroad or delivered at ports for shipment . . . Dayton Wright Airplane Co. completes the 1,000th "deHavilland battle plane" . . . Army tests two-place fighter designed and built by Grover C. Loening.

15 Years Ago (1928)—John Paul Wood, in a J-5 Waco 10, wins National Air Tour. Prizes of $200,000 are announced for National Air Race winners . . . Five-day maneuvers theoretically "bomb" London, and press "estimated that in actual warfare half of London would have been laid in ruins" . . . Government moves to establish "secret list" on combat planes, keeping performance and specifications confidential for 12 months . . . Three attempts at east-west Atlantic crossing fail due to "plumbing" trouble . . . Asst. Navy Sec. Edward P. Warner takes delivery of new Vought *Corsair,* first of 135 being built for Navy and Marines . . . Dean C. Smith joins Byrd Antarctic expedition . . . Navy pilots lead services dedicating Lindbergh Field . . . New planes this month include: Boeing F4B carrier fighter powered by 500 hp. *Wasp,* with top speed of 182 mph and service ceiling of 30,000 ft.; Boeing 247, twin-engine transport; Lincoln-Page 3-place open biplane for OX-5 or 150 hp. Hispano; Elias & Bro. *Aircoupe,* convertible from open to closed type, with 80 hp. Anzani; Travel Air 6000, J-5 powered 6-place transport; Pitcairn *Super Mailwing,* with 22,500-letter capacity; O. W. Timm's 5-place cabin biplane, tested by Roscoe Turner; Keystone *Sign Carrier* for aerial ads . . . Jack Frye, Standard Air Lines president, announces extension of Los Angeles-Tuscon line to Dallas . . . "After the present fiscal year, no more *Liberty* engines will be installed in new planes.

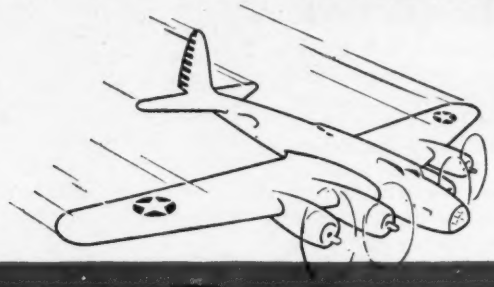
A New Dunco
DYNAMIC-BRAKING RELAY

FOR SPLIT-SERIES FIELD AIRCRAFT ELECTRIC MOTORS

Instantaneous dynamic-braking with split-series field motors is provided by this new Dunco Relay development, Types 68HX100 and 67HXX100.

Positive action, less weight, and simpler mechanisms are thus provided for a wide range of aircraft applications. These include the operation of retractable landing gears, wing flaps, trim tabs, bomb bay doors, hoists, and similar applications utilizing reversing motors. For winch operations, the relays permit a simple locking dog to be substituted for the conventional large magnetic brake.

The Relays are of the famous Dunco "Nutcracker" type with the new, light-weight construction, and having exceptionally strong contact pressure. There are no sliding contacts. Dunco positive "Memory" contacts select the proper field winding to give reverse torque for braking. All parts and contacts are readily accessible for inspection. Although the Relays represent a radical new design they are actually only a new combination of proved components, every detail of which is time-tested. They operate in all positions, and withstand salt-spray, vibration and altitude tests.



STRUTHERS-DUNN, Inc.

1321 ARCH STREET, PHILADELPHIA, PA.

DISTRICT ENGINEERING OFFICES: ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • HARTFORD INDIANAPOLIS • LOS ANGELES • MINNEAPOLIS • MONTREAL • NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO • WASHINGTON

Management
—Heart of America's Industrial Progress

In Peace and War, Management Men and Methods Steer Production on a Steady Upward Course

WHEN the Allied armada of 2,000 ships, protected by a vast umbrella of planes, struck the coast of Sicily, Axis leaders once more had reason to wonder how "that decadent, pleasure-loving America" had swung from the manufacture of automobiles, refrigerators and costume jewelry to equipments of war, and had out-produced such mighty plants as the Krupp, the Fiat and the Skoda works — and had done it so quickly.

America at war is in the lead just as it has led a world at peace. Super-performing planes are taking to the air at the present rate of nearly 100,000 per year. Ships, to carry the war to our enemies, slide down the ways at the rate of two a day. Tanks, trucks, guns, ammunition are pouring out of our "peace" plants in far greater volume than the entire Axis effort can possibly equal. War expenditures in 1943 alone will reach the staggering figure of approximately $83,000,000,000 — an amount equal to our entire national income for 1929. Added to this is the rock-bottom output of essential civilian goods — a very considerable item.

This unprecedented production is taking place while some 9,000,000 men and women, those physically best equipped, have been called to the armed forces. Many of them were taken from industry, and their loss could be repaired only by more efficient equipment and more effective methods.

Rigorous training programs had to be superimposed upon many other abnormal problems facing industry in its high-speed conversion from stoves to boats; from printing machines to guns; from automobiles to airplane engines; from fishing tackle to bomb sights.

This phenomenal task was further complicated by the need for rapid expansion. A modest machine tool industry had to be expanded to handle a volume many times its normal capacity. Steel production had to be increased by 20%, and that of aluminum and magnesium multiplied over and over. From almost nil, the demand for high octane gasoline soared to unbelievable quantities. The creation of synthetic rubber and electronic industries was necessary almost overnight.

Who deserves credit for these accomplishments? All industry! The engineers, chemists, designers, skilled workers, common laborers. But over and above all it belongs to *management.*

In industry it is mandatory to have a directive force to co-ordinate the efforts of men in the use of materials and the application of power toward the production of goods and services. The application of this directive force is the function of management, and only because we had today's kind of management were we able to transform ourselves, almost overnight, from a peace-loving nation to the world's greatest producer of implements of war. As a nation, we had been preparing for a long time to play our part in world affairs. This preparation, certainly not planned for today's objectives but none the less effective, began some four decades ago.

With the advent of the twentieth century, the character of industry in the United States, and, therefore, the character of American living, began to change. Scientific management was born. Frederick W. Taylor brought into focus and showed how to use effectively those processes and procedures upon which our present-day mass production is based. He was followed by Harrington Emerson, who made the industrial world acquainted with efficiency in manufacture and the remarkable progress to be gained therefrom in the field of production, with its consequent price reductions and wider distribution of industry's products. There followed, in industry, an alert management, a capable management, a management with vision. Without it, the work of Taylor and Emerson would have gone for naught.

It is because of this early work of management — and the extraordinary developments it produced — that the country as a whole, and particularly those employed in industry, were not over-awed by the seemingly impossible job of quick conversion to all-out war production. But let us look back four decades and examine some of those preparatory accomplishments which have proven so vital to the progress and welfare of the nation.

From 1900 to 1939 (the last pre-war year), total employment of all kinds increased 52 per cent; in the manufacturing industries alone the increase was 84 per cent. *The nation became definitely industrial.*

In 1900 the average wage earner was able to spend only 20.2 per cent of his income for things other than necessities; in 1930 his buying power for non-essentials had increased to 34.8 per cent. *The average man acquired confidence in what industry could do.*

In 1900 the average work week was 56 hours; in 1930 it was 48 hours. *The burden of production was being transferred from man to machine.*

In 1939 the United States possessed 30 per cent of the world's railroads, 72 per cent of its automobiles, 49 per cent of its telephones. *The nation's production equipment had grown to formidable proportions.*

In 1939 nearly half of the families in the United States owned their own homes, 64 million individuals carried life insurance policies and 45 million had savings accounts. National income had increased 300 per cent from 1900 and during the same period the proportion of national income paid out in salaries and wages increased from 58 to 70 per cent. And in less than this period (1914–1939) the purchasing power of the wage rate increased by 60 per cent. *There had been evolved the kind of living for which men will work — and fight.*

Since 1900, factories increased their output of goods from $11,000,000,000 to $60,000,000,000 in 1939. This increase of nearly 450 per cent was accomplished while the country's population rose only 60 per cent. In this same span of years, technological developments and improvements in methods had

increased the value added by manufacture per wage earner by 200 per cent, and the horsepower per factory worker had been multiplied by 2½. *The nation's production plant was ready to assume its gigantic wartime job.*

During this period of industrial and national evolution, management itself had changed. Prior to the advent of scientific management, our goods and services were the product of several kinds of directive activities, varying from the strictly paternalistic to the ruthless. There was little conception of the responsibility that industry now broadly acknowledges — the responsibility of trusteeship in the interest of stockholders, employees and the public — specifically; in the interest of our national economy — generally. Acceptance of this stewardship is acceptance, also, of the belief that, in the long run, no industry, and no unit of industry, that does not serve society can live.

Have the actions of management caused the times to change? Or has an alert management been successful only because it has changed with the times? Certainly, the industrial concern of 1900 would not thrive under the conditions of today. Just as certainly the new things that industry has in store for a waiting postwar world will have a far-reaching effect upon the times.

Management today seldom owns the factory or the business it manages. It is hired to perform the coordinating, directive functions. It is free to change — of itself, or with the times. Management therefore exercises its power through leadership in executing ideas . . . not through ownership.

This is the fourteenth of a series of editorials appearing monthly in all McGraw-Hill publications, reaching more than one and one-half million readers. They are dedicated to the purpose of telling the part that each industry is playing in the war effort and of informing the public on the magnificent war-production accomplishments of America's industries.

Good management can be sustained only in an environment sympathetic to its aims. It has an undeniable obligation to society, because it must be a compatible part of the social structure or be rejected by that structure as a whole.

An environment sympathetic to its aims means, also, that industry, in the very serious reconstruction period ahead, will not be at full effectiveness if it is subjected to attacks by government no matter what the underlying reasons may be — over-zealous devotion to a cause, lack of understanding or just plain politics. It was to industry — to industrial management — that the government turned when our existence as a free nation was threatened; it is to industrial management that government must turn in order to win the peace.

This statement is made in the sincere conviction that what has made America strong is industry's ability to produce consistently more and more goods and services for more and more people. It is only by actually creating them that we built up our stockpiles of the necessities of life. And it is only by creating them that we can have more of those things that make life worth while. These become available to more people as industry succeeds in getting greater output of goods and services for a given input of human energy, materials and power.

And what of the physical jobs ahead? In this country alone, there will be an immense demand upon industry to supply the things people have been unable to purchase during the war. Today the nation is wearing out not only its automobiles, refrigerators, vacuum cleaners and radios, but its very houses, its roads, railroads, and airline equipment. It is saving its money while whetting its appetite. Truly, the calls the American people will make upon industry in the postwar period will be many and insistent.

This demand can be viewed in another light. Economists say there will be 56,000,000 persons seeking gainful employment after the war. The Committee for Economic Development has estimated that $140,000,000,000 worth of goods and services will be required each year for those people. Compare that with our actual output of $97,000,000,000 worth of goods and services in 1940 when gainful employment was 46,000,000.

These future jobs will be done if industry's management is not too much hampered by government management. Management in industry performs its function in the field of *doing* things. Management in government performs its function in the field of *regulating* things. The best cooperation of the two kinds of management will be necessary in the postwar period. Certainly, too much of the regulatory kind will interfere seriously with the kind that does things.

Industrial management must improve, too. If it is too selfish, if it does not recognize definitely the trusteeship inherent in its job, if it does not understand and live up to its social responsibilities, then it will be risking all for which we are fighting. The following suggestions are made to indicate the direction that management's self-improvement can take.

Evolution in management has been too slow in some respects. Management in industry has been too prone to see the advantages in technological development while being blind to its evils. Looking at industry and social progress as a whole, there can be no doubt as to the value of technological improvement. It creates jobs. It elevates the standard of living. But that economic fact is of no satisfaction to the individual who loses his job because a new machine or a new method required one less man. By and large, this is an evil that management can do something about.

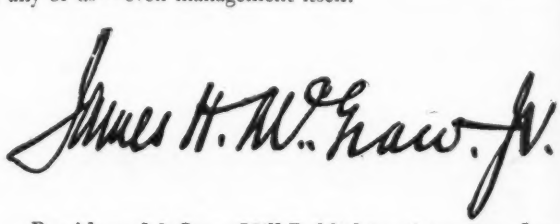
Management has been too careless of its opportunities with regard to labor. On that account the pendulum of social readjustment has swung too far. Labor has been given extensive privilege without corresponding responsibility.

Industrial management has been too slow to abandon its policy of letting the buyer beware. As a result of this, industry today is over-regulated.

Management has been too slow in recognizing its responsibility to promote the economic philosophy that a society cannot have for consumption what it does not produce. A companion educational item too long neglected is management's obligation in the field of public relations.

In these years since 1900, industrial management has been growing. Perhaps many of its experiences have been but growing pains. Management has learned, among other things, the absolutely vital need for capital at the right time and in the right amount. It has learned to use some of its earnings as "seed-money" in the introduction of new products and the use of new processes. It has learned to invest more and more in research. It has learned of the interdependence of industry and agriculture. And it has learned much about the eternal triangle of industry, labor and government.

With such a history and such experiences behind it, I have every faith that management is going ahead to even more glorious accomplishments in the winning of the war, and I believe that its peacetime accomplishments to come are beyond the prediction of any of us — even management itself.



President, McGraw-Hill Publishing Company, Inc.

Calling the Tally on the Truman Report

CONGRESSIONAL INVESTIGATIONS are the foundation of democracy, and when they are constructive they serve a salutary purpose. Unfortunately, these reports are rarely read in detail by the citizens for whom they are intended. Usually only those portions that savor of scandal reach the public by newspaper or radio.

The aircraft report of the Truman Committee is a good job. It shows plenty of hard work on the part of the Committee, a reasonable grasp of the subject; it gives credit in many instances where it is due, and it spares no man from criticism. For this, it is to be commended.

But it also shows certain inconsistencies, some convenient shortness of memory. And it reveals strategic information that will give considerable comfort to the enemy. For example, the enemy now knows that it need not fear increased strength in Army dive bombers and that the Navy hasn't any helicopters, to mention but two of the strategic revelations. Five new aircraft, heretofore on the restricted list, are mentioned in some detail in the report. The enemy does *not* furnish us with that kind of information about his equipment and strategy.

The report begins properly with high praise for the aircraft production effort, but on page 3 it becomes wistful and says that "in a great many cases, we could have done better than we have." Of course, we could if, when we started, we knew all the things we now know. The Committee should remember, for example, that no man in the hysterical Washington of 1940 dared to curtail the dive bomber program in the face of the demonstrated usefulness of this equipment by the Germans in the Battle of France.

Most of the criticisms of the Army, the Navy, and the industry can be laid squarely on the Capitol doorstep. In one instance the War and Navy Departments are taken to task because they "multiplied the proposed output of a plant instead of seeking additional sources of supply," and "one company received too many contracts with the result that its engineering departments and skilled personnel were spread too thin." But the critics conveniently forgot that it was their own august body that starved out our aviation industry while Germany was expanding its own, also that only a few months before war was declared in 1939 there was much talk in Congress about economies in the 5,500 plane program.

Congress, and Congress alone, is to blame for the low base upon which expansion of the aircraft industry was started. And that base would have been even lower if the industry had depended upon Congress for military aircraft appropriations. Much of the industry would have folded up long before the war if it had not had the initiative to go out and get enough export business to keep it going.

THE CONGRESS and the people should be fervently thankful that the War and Navy Departments possessed the wisdom that led them to place orders where experience taught them they would have reasonable assurance of their fulfillment. And even to this date, many of the additional sources of supply, which were sought when the aviation industry became overloaded, have not caught up with the output of the parent aviation companies.

No one will disagree that experienced supervisory personnel has been spread too thin in every aircraft company. This again is because of the smallness of the prewar industry. It is going to be worse before it is better because of expected severances required by Selective Service. A constructive move on the part of the Committee would be to do something about the "unwillingness on the part of the draft boards to recognize the importance of the work" which it reluctantly concedes to exist.

A most glaring inconsistency is found when the battle-scarred P-40 is trotted out again and the Army is accused of ordering too many of them in the early stages of the war. The reason for this is simple. The P-40 was ready for production and the Army wisely decided to order what was available and not sit back waiting for improved planes to come along. But earlier in the report it is recommended that "we should not attempt mass production of an entirely new model incorporating a whole series of major improvements until after it has been tested and proved".

OUR ARMY followed this procedure exactly when it placed the early large orders for the P-40. This plane may have been "relatively obsolete when we entered the war"—but it has been shooting down Zeros at such an overwhelmingly high rate for so long that no newspaper reader can take this charge too seriously. Wars will always be fought and won with "obsolete" airplanes, and the nation which tries to build its latest types before they are ready for production, without improved designs coming along, will be on the losing side.

Newspaper readers and radio listeners will be deeply impressed by the sensational charges of irregularity in inspection methods. Although the report points out that the case in point has been corrected, this is still a very serious matter. But the Committee and the Army seem to disagree on the magnitude of the transgression. In all fairness, judgment must be reserved until other investigations are complete. It is definitely undesirable to eliminate the safeguards provided by careful inspection. But there are many instances in which better and quicker results would be obtained if specifications were written requiring a set standard of over-all quality and performance for a given product, leaving the detailed steps by which that standard is to be obtained to the discretion of the contractor.

It would be folly to contend that the magnificent achievements of the aircraft industry have been accomplished without mistakes or that hindsight could not show ways by which the performance could have been more efficient. If the so-called irregularities reported by the Committee are all it was able to find in an extended period of investigation, then the percentage of error is practically infinitesimal.

The true value of disclosing parts of our strategy to the enemy, forcing production men to take time out to defend themselves for abuses long since corrected, and unnecessarily undermining the confidence of new military pilots, must be weighed against that of presenting a collection of facts and inferences that add nothing new to the existing knowledge of those who should know about the production program.

In the proposed investigation of the future disposition and use of American built air bases, the Truman Committee has an opportunity for a much more constructive service to the nation.

Leslie E. Neville

EDITOR

AVIATION'S
WAR COMMUNIQUE
NO.20

America at War

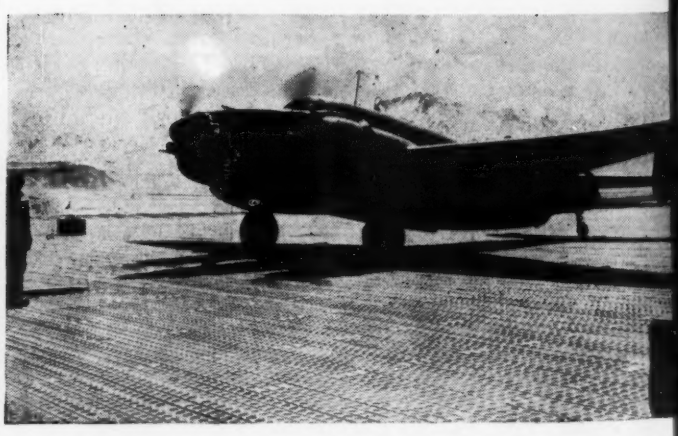
**All-out air assaults are commended by Gen. Spaatz . . .
and Hitler newspaper confesses air war is "damned serious" . . .
Channel, Russian, and Mediterranean theaters split Luftwaffe three ways . . .
Japs "at least status quo-ed" . . . Home front gages potential headaches.**

AIR POWER applied in overpowering force against an enemy objective can eliminate it. This is the reported statement of Maj. Gen. Carl A. Spaatz, deputy commander of Allied air forces in North Africa. It is the first declaration by an Army official which would meet the full approval of a "pure air power" advocate. However, Gen. Spaatz did not say that Allied aviation is being used in accordance with this theory. Fact is, it is not being so used and probably won't be, in this war. But more and more of the men up high, including Gen. MacArthur and Secretaries Stimson and Knox, are in agreement on the theory, and practice is coming closer to it.

Each month brings new evidence of weakness in Germany. Several times recently, the Axis radio has made surprising admissions of damage done by air attack. They predict invasions in the same way that the British did when they were scared stiff. One announcer recently went so far as to mention the possibility of Axis defeat. Multitudes of people are being pulled out of the Ruhr Valley, and what industry is haulable is being trundled eastward as fast as possible. Production of some essential goods recently has been observed in hastily constructed plants under the open sky.

Months ago the Army had information that Germany would run out of some essential stuff at an early date. Perhaps it has happened. But at this writing no report, official or otherwise, has shown the enemy short of any-

All Photos by International



Escorted by sleek Bell Airacobra fighters, Douglas C-47 *Skytrain* speeds over rugged interior of New Guinea with supplies for our forces battling Japs in northern reaches of island. Note auxiliary fuel tanks carried by P-39's on this extended run.

On isle of Adak in Aleutians, Navy Vega *Ventura* warms up for bombing mission against Jap-held Kiska, 244 mi. distant. Top picture, snapped earlier, shows slough of mud and ruts which our hustling Seabees tackled and turned into neat metal-stripped fields.

Another wallop out of the sky for Italy. City is Leghorn, and box-finned 500-lb. bombs, loosed by Boeing *Flying Fortress*, are seen hurtling down upon large oil cracking and refining plant visible in central portion of picture. Leghorn "show" also accounted for 390 freight cars and six ships along quayside by precision bombing, which Italians—on and off Sicily—now know too well.

thing except airplanes. Everybody, on both sides, is still short of aviation, but the Germans are chaotically short. Their industrial works, cities, and transportation are frequently being hit without adequate defense.

As Germans were reported leaving their bombed cities in large numbers, Berlin dispatches to Stockholm reported that raids were having an "awful" effect on morale. "The air war is a damned serious affair," Hitler's newspaper said.

Many people have wondered why the Nazis have shown up with so relatively few planes for attack and defense in the West. This Communique has discussed it before, quoting various sources who admitted they were guessing. The matter has recently been explained rather logically. The original Luftwaffe was, initially, strong enough to take on and defeat with ease the combined air powers of Europe, with the United States thrown in. Never did Goering intend that any enemy should survive long enough to build a strong opposing air force. (He thought the United States would not really get started until after Europe and England were knocked out.)

But a little matter of qualitative superiority in the *Spitfires* and *Hurricanes* bought some time for the British and for the United States. Then Hitler crossed the Russian Rubicon, and that split his air force between the Channel and the Soviet front. And when the Allies invaded Africa that split the Luftwaffe three ways. The press will tell you that the Axis has its hands full in both the Russian and Italian theaters.

All this was not according to Axis plan. Furthermore, what had seemed to prewar visitors in Germany, and to early Nazi victims, like an unbeatable air machine, was really bush league when the big boys got going. It's now held that Germany never, at any time, had more than 5,000 first-line planes in operation, with another similar number in reserve.

True, that is a lot of airplanes, parked in dispersal and ready for action, as we ourselves found out when we first began to equip both the Allies and ourselves. But it was far from being enough.

So it is that weak as the Nazis are in the air, and taking the beating they are, they show no weakness on the ground, as yet, as a result of it. Maybe they really are getting tired of their rations; maybe they have lost 30 or 50 or 70 percent of their war spirit; maybe their internal enemies are within a few pounds of popping-off pressure. Still, it doesn't show and you can't count on it. In our Allied airminded hearts is the hope, and probably the wishful belief, that signs will soon appear, indicating that overhead attack will turn the trick, making occupation by the walking Army nearly bloodless. But nobody can depend on it.

It is interesting to imagine a peek, from the other side of the fence, at the German people taking a pounding very much worse than the English towns ever took. The English were free to yelp and call quits if they wanted to. The Germans are not. If they were their own masters, would they have hollered uncle before

(*Turn to page* 290)

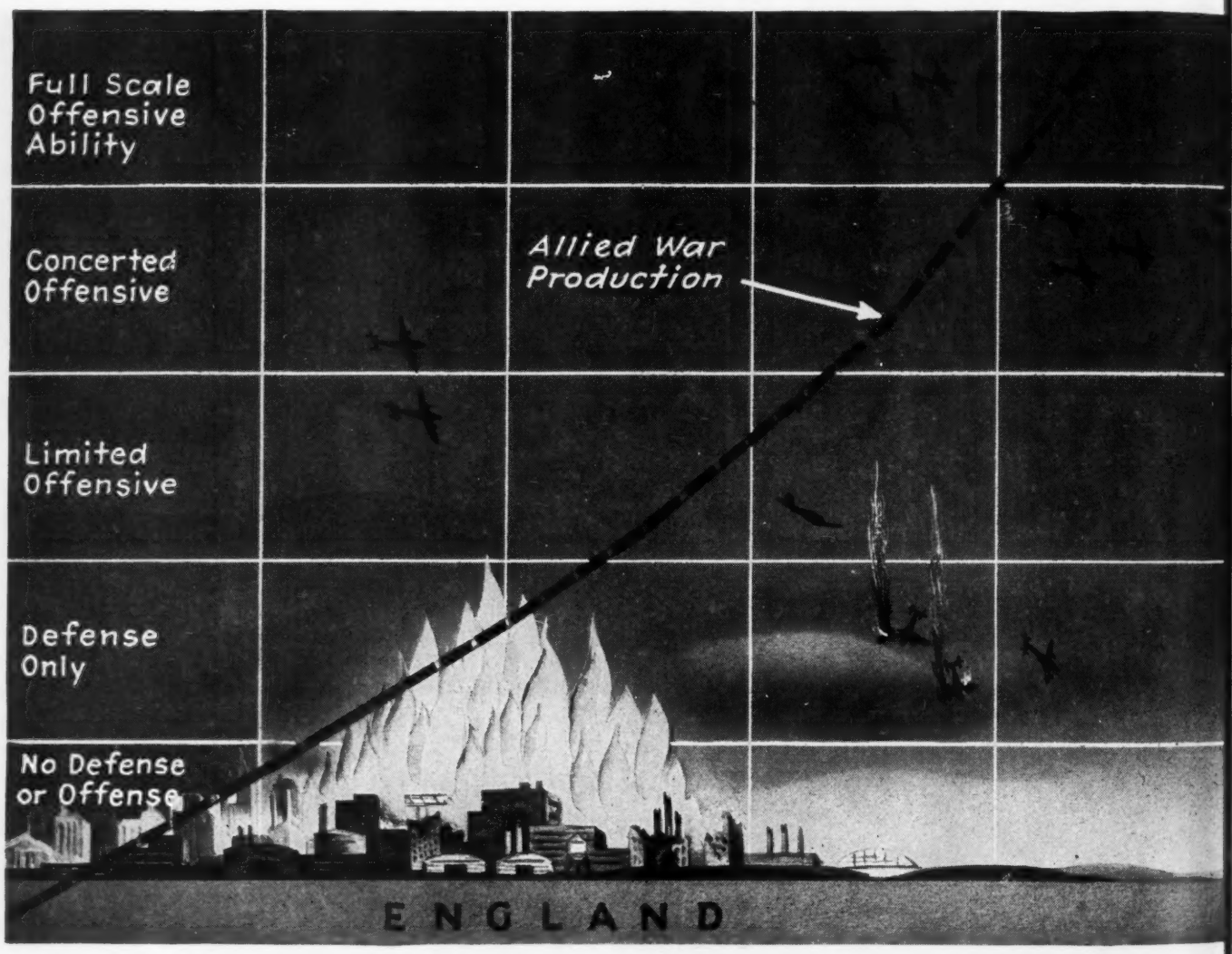
Bombing . . . the American Way

By E. EUGENE MILLER
Managing Editor, "Aviation"

Efficiency dominates the thinking of American bombing strategists and tacticians. In the first of two articles on American bombardment doctrines the meaning of strategic bombing is discussed and the tools of tactical employment are appraised in detail.

THE BOMBER COMMANDS of the Army Air Forces look upon their mission as one of destroying *by the most efficient possible methods* the enemy's power to resist. Efficiency in the bombardment function applies to both the strategy and tactics of bombing. Although it is sometimes not apparent, the strategic aims of bombardment are pretty similar among all contestants in this war. It is very apparent, however, that the *full significance* of these strategic aims is not equally appreciated by all contestants. If it were, there would be little variation in the tactics employed by them—if such employment were within the power of all.

To clarify this premise for a minute, one merely has to take a quick review at athletic sports and sports history. In the first place, the older the sport the more standardized are the competitive tactics. This is because, as a matter of evolution, the consistent trend toward more efficiency in sports performance automatically eliminates tac-



THE LESSON OF STRATEGIC BOMBING

When the Nazis started the air offensive against Britain in 1940, their war production had been in full swing for many years, giving them, at that time, the power for a concerted effort. (It was then considered an "all out" offensive, but war requirements, as we know them now, have changed definitions.)

Despite the terrible bombardment of England, Britain's war production rose steadily until she not only had the ability to resist, but could fight back. Britain's resources grew to the point where she could undertake a concerted offensive and finally with full Allied participation, the effort has reached "all out" proportions.

ties which are not efficient. It eventually boils down to the point where, within the rules of the sport, a limited number of tactics are available for employment to win, and the only new winning tactics open to development are those of a higher efficiency factor than those currently in use. If such new tactics are developed, they are immediately adopted by all contestants, provided (a) it is within the power of all contestants to employ them, and (b) the full significance of their employment is equally realized by all. Contestants not capable of either (a) or (b) usually lose.

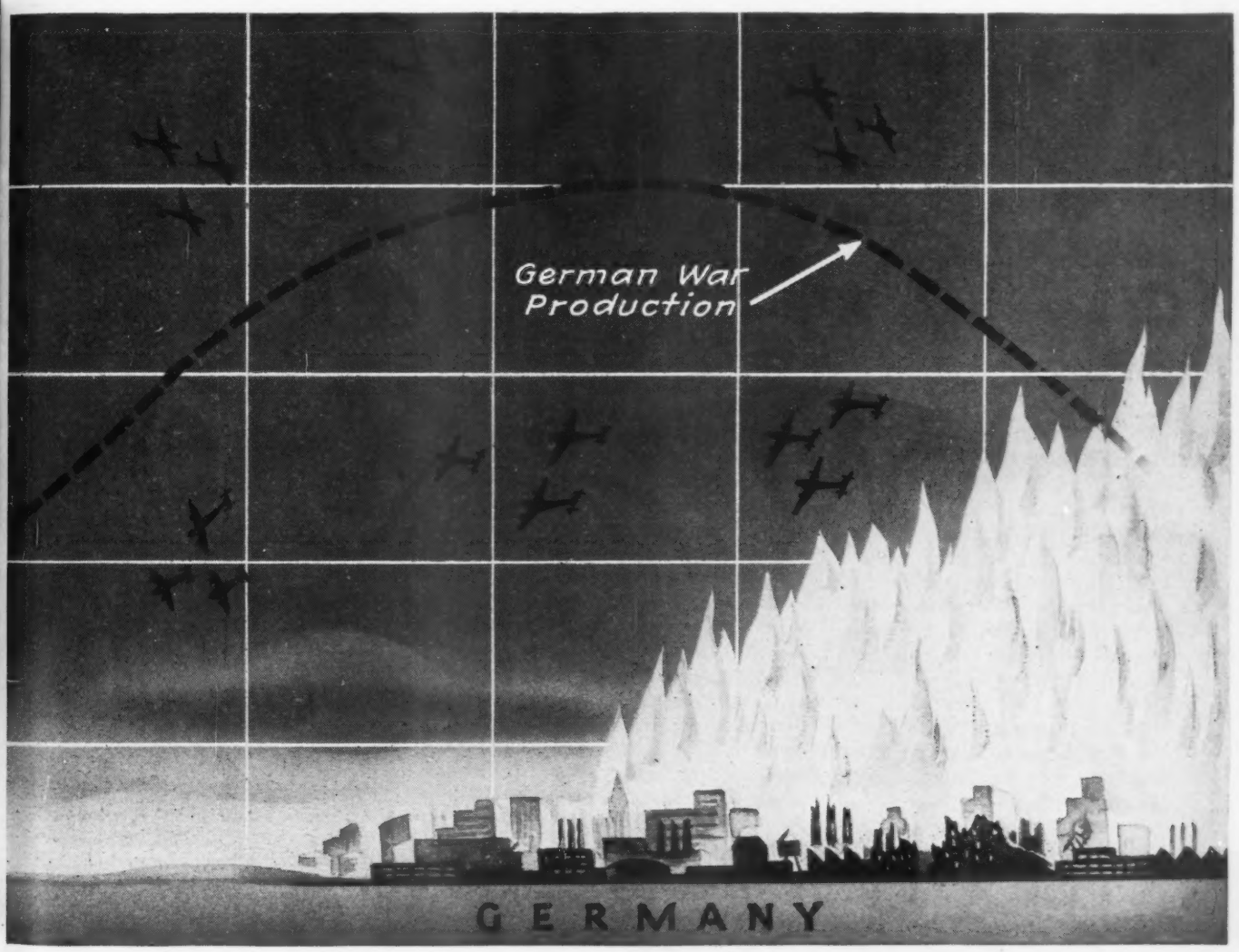
In football, for example, nearly all of the plays in a team's repertoire are standard, tactical moves developed through the years by individual coaches and adopted by all others as their success was observed. Almost every season, a new tactic is devised by a coach which proves successful and gives his team a temporary advantage over others. If this tactic is efficient, it continues to enjoy employment and is generally adopted by other teams as a standard play. The measure of efficiency is the ground-gaining capabilities of the play, and if it is inadequate to the extent that the defense can stop it consistently, it is discarded. With this evolution of development and test, most football teams enter the field with all but one or two of their plays capable of execution by everyone, and the game becomes a contest of employment skill of these standard maneuvers.

To date, air bombardment has a relatively short history. Its strategic implications are realized by almost everybody, but the wide range of divergence in tactical thinking among the contestants indicates that they are a long way from ultimate efficiency, thus presaging a very successful outcome for those whose tactical thinking is based on attaining the maximum in efficiency.

Even a casual analysis of what AAF Bomber Commands are doing will reveal that a striving for efficiency dominates the strategic and tactical thinking.

By and large, their selected targets are strategic, and as almost everyone agrees that to knock out the enemy's *source* of immediate and cumulative power of resistance is efficient strategy, the record is obviously good. The British have always pursued this highly effective policy; the Russians began as soon as they were able—and they are becoming more able as each week passes.

The Axis "blitzkrieg" policy led our enemies away from the concepts of strategic bombing. The Germans developed



The Nazis failed to stop Britain's war production because they erred strategically. They thought they could crush Britain before she could muster the power to resist. They neither would not nor could not attack and destroy the source of that power. Germany would not because she gambled on demoralization tactics and a quick and cheap victory. She could not because she was not equipped with sufficient or good enough equipment to effect sound strategic employment. Besides, a great measure of Allied productive capacity lay out of reach—in America.

In mustering the power to strike back, the Allies built aircraft designed to bomb German war production centers and destroy her sources of supply. The time of victory will depend on how rapidly the Nazis production curve is battered down—and that depends on how efficiently the tactics of bombing are employed.

highly efficient tactical weapons such as the dive bomber and attack bomber of medium size. The tactical success of these aircraft in the initial stages of the war is well known, but when tactical envelopment was stopped in the Battle of Britain, and the attrition stage reached, as it *must be* in global warfare, Germany was found wanting in strategic weapons.

If in her development of air power Germany had adopted the concepts of efficient strategic bombing, she might have stood master of the world in 1941! Despite the fact that Britain was subjected to the most frightful bombardment to that date, her war production mounted at a steadily increasing rate until she had actually amassed enough power to strike back even before American production was thrown in full gear on her side. The Nazis therefore failed to stop Britain's ability to resist.

Rarely has the vaunted German intelligence been so dismally put to shame as in the Nazi error of air. It is not the intent of this article to review this classic series of blunders in detail. But they will be obvious if in the following description of American bombardment concepts it is recalled that the Nazis did not choose targets of production; they did not have bombardment aircraft capable of self defense; and they elected the tactics of inefficient "saturation" bombardment without possessing the essentially colossal resources needed to actually saturate the target areas. The Nazis unwittingly began a battle of attrition in the Battle of Britain and they didn't know it. They exhausted themselves in wasteful employment of aircraft and bombs, and they were finally struck down by the true attrition tactics of the Allies—which, be it noted, did not involve bombardment of Berlin!

It is believed that the prime lessons of air strategy are now learned—and at a time when the Allies have a preponderance of air power and the strategic initiative to prevent the Axis from even attempting to catch up. This favorable balance of arms does not mean that the struggle is won. To be perfectly realistic, we may summarize its meaning to date simply as follows: *Through misconception of the use of air power, the Axis lost its ability to win the war quickly and cheaply.* This is not to say that our enemies have lost the ability to win the war—because unless we use our air power properly, the cost of total victory may well become prohibitive. The Allies are now *starting* their offensives against vastly more formidable power than the Axis faced when it undertook the offensive. The penalties of blunder and inefficiency are no less great, and we are to be subjected to violent test. Air bombardment is our principal strategic offensive weapon, and upon its proper employment will depend our ability to do what the Axis failed to do, also the cost of the total effort.

Therefore tactics and tactical organization and equipment comprise the vital consideration and as the AAF places just as much importance on efficient tactics as efficient strategy, we must define tactics in those terms and see how the AAF measures up. Efficient bombardment tactics involve an efficient organization utilizing efficient equipment to carry and direct the right bombs toward the destruction of a strategic target in the most efficient manner.

Bombardment Organization

A really efficient organization is generally one which is flexible enough to adapt itself to any number of potential situations. The Bomber Command of our Army Air Forces contains the usual echelons of command, but the size of each may vary according to the circumstances. The degree of flexibility is most marked in the higher echelons of command, but in actual practice a considerable degree of flexibility exists right down to the—

Combat Crew

The *combat crew* is the basic tactical unit of the bombardment organization. This is differentiated somewhat from the fighter organization where a "Flight" is usually the basic tactical unit. The combat crew will vary in size according to the type of airplane in use but will also vary within similar classification of aircraft depending upon the mission to be performed.

The best bomb, the most accurate bombsight, and the most perfectly designed airplane are no better than the men who use them. Furthermore, the most efficiently organized air force in the world is dependent for its effectiveness upon the performance capabilities of the combat unit, namely, the airplane crew. There are many things that can be stated about air force operations with mathematical certainty, but there is no more emphatic truth than the assertion that bombardment crew efficiency is a direct function of practice. Therefore our policy of protecting and preserving personnel, even at a sacrifice of performance, is sound. It can be stated with equal emphasis that any deterioration in efficiency of a bombardment crew requires a tremendous increase in force and effort, vastly out of proportion to the loss in efficiency, to do a given job. An Army Air Forces commander summed up the whole thing in this single statement: "Nine men in an airplane will never replace the combat team."

It is a simple matter to demonstrate that combat crew efficiency can be projected in terms of air force efficiency. A decrease in the average error of a combat unit is equivalent to an increase in the number of effective airplanes in a given theater of operation. Bombing tables show that to obtain 85 percent assurance of at least three hits on a target 50x450 ft. in dimension, 20 bombs are required if the radial probable error is 100 ft.; 52 bombs are required if the R.P.E. is 200 ft.; 275 bombs are required if R.P.E. is 500 ft.; and 1,200 bombs are required if the R.P.E. is 1,000 ft. In other words, a bomber force of 52 airplanes with reasonably well trained crews whose radial probable error is 200 ft. is equal to a bomber force having 1,200 airplanes with poorly trained crews showing an error of 1,000 ft.

So important is the matter of crew training that many American tacticians hold to the belief that a bomber force should be held in abeyance until the proper degree of both force and practice is accumulated for a particular assignment. These men believe that a mission can be carried out most efficiently by awaiting ideal attack conditions with respect to weather and visibility, meanwhile having the bomber crew practice unceasingly as a combat team. They hold that a given target or series of targets can be destroyed by an organization well practiced in pre-

Effect of Strategic Bombing on Ground Forces Requirements and Losses

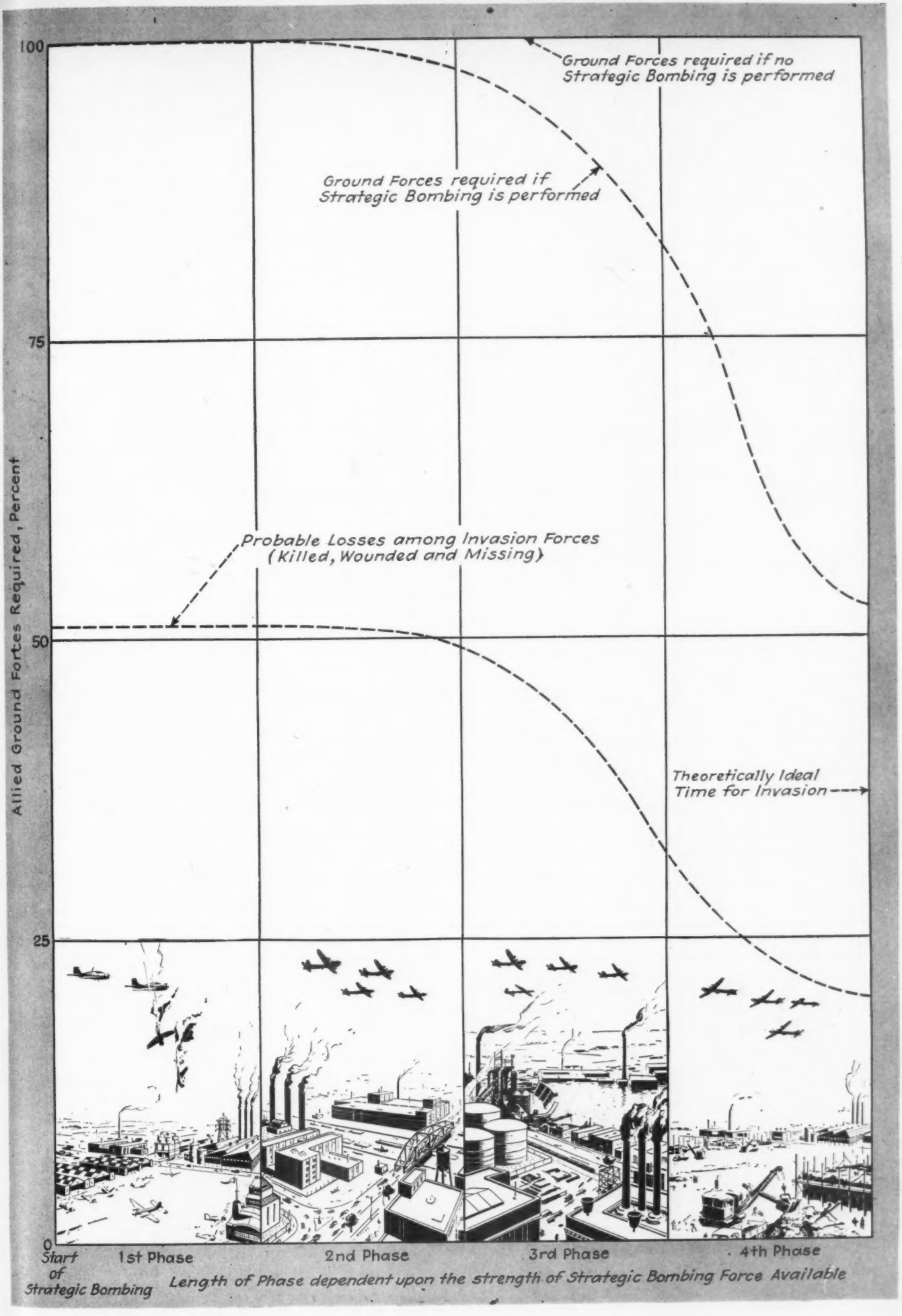
First Phase: Shallow penetration. Reduction of enemy air defense. Targets are fighter factories, flying fields, fighter aircraft.

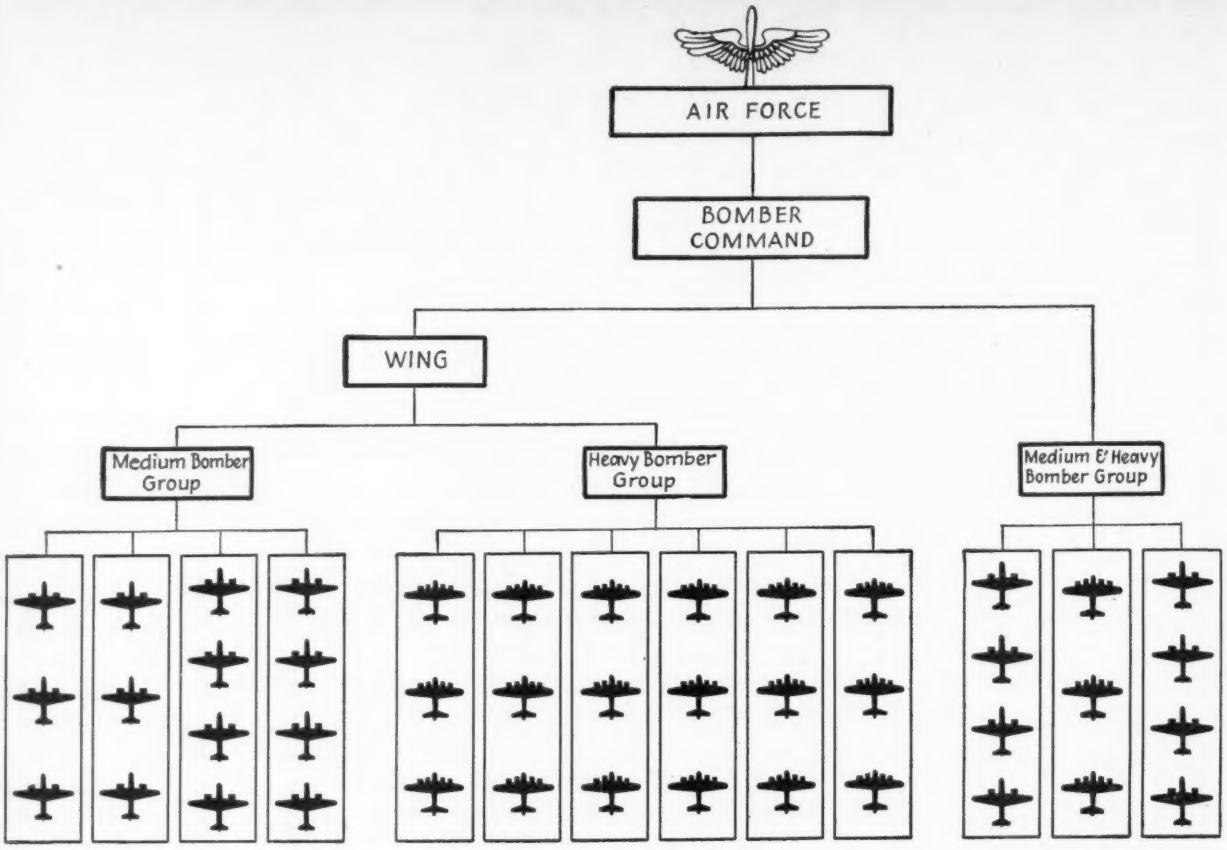
Second Phase: Deeper penetration upon stopping growth of enemy defense. Phase ends when defense is on decline and way is clear for "all out" offensive.

Third Phase: Knock out enemy production capacity, thus reducing power to resist. Selection of targets which contribute directly to enemy's front line forces. Establish internal decay causing enemy defense perimeter to become an easily puncturable crust.

Fourth Phase: Cleaning up overlooked targets. Destruction of other targets contributing to rebuilding of armament factories. Final preparation for invasion which takes place at completion of phase.

Reduction of ground forces required for invasion and conquest, and a minimum of losses in personnel and equipment is the tremendous reward of planned strategic bombing. Length of each bombardment phase depends on scope of enemy power, strength of bomber force employed, and efficiency of operations. Each of these factors, too, has a bearing on cost of the effort and magnitude of the result.


100
75
50
25
0
Allied Ground Forces Required, Percent
Ground Forces required if no Strategic Bombing is performed
Ground Forces required if Strategic Bombing is performed
Probable Losses among Invasion Forces (Killed, Wounded and Missing)
Theoretically Ideal Time for Invasion
Start of Strategic Bombing
1st Phase
2nd Phase
3rd Phase
4th Phase
Length of Phase dependent upon the strength of Strategic Bombing Force Available



BOMBARDMENT ORGANIZATION

The Flight may be defined as the optimum number of airplanes over which one individual can maintain control in flight. Considerable experience has proven that three is the desirable, if not optimum, make-up. Visual contact among the three airplanes is good, and the formation of three airplanes is almost as maneuverable as one. Actually a Flight is the first element of tactical control, and while the Flight leader does not have administrative control, he is responsible for employment of tactics. Four airplanes are generally assigned to a Flight, three of which are normally expected to be in commission.

The Squadron is the lowest echelon of command having administrative duties. The Squadron commander is responsible for the three main divisions of air force activities; namely, detail administration, technical ground services, and coordinated air tactics. Under normal circumstances, a Squadron consists of three or four Flights, with which a great variety of formations for attack and defense can be worked out. More than four Flights may become too cumbersome to handle, but circumstances in particular theaters may dictate considerable variation from normal without appreciable loss of efficiency.

The Group is the very heart of tactical command. A flexible organization, it may be composed of from one to as many as six Squadrons. It generally has a headquarters and is capable of making decisions on tactics, including bomb types and quantities necessary to accomplish a mission. Under normal circumstances, a bombardment Group will work with only one type of aircraft, that is, heavy bombers or medium bombers; but under certain circumstances both types may be included under the command of a Group.

The Wing is merely another command which may become necessary in order to subdivide tactical command responsibility where there may be concentrated a very large number of bomber units which must operate together at a considerable distance from the Air Force or Bomber Command headquarters. Where such concentrations are not necessary, a Wing organization may not be needed at all. The entire organization of a Wing will depend entirely on circumstances and this will apply as well, to types of aircraft under its command. Command prerogatives of the Wing commander correspond very closely to those of the commanding general of the bomber Command itself.

The Command is the highest echelon of command, but nevertheless it is only a specialized subdivision of the all-inclusive **Air Force** authority and responsibility.

cision bombing in less time than that required in mass "blind" area bombing, with considerably less cost.

No little amount of weight was given to this line of thought by the recent British mission against the Ruhr Valley dams in Germany, where the attacking force was carefully trained for a considerable period of time for the job, was held in abeyance until conditions were ripe, and scored one of the war's most staggering blows against the enemy in a single action.

The American bomber command in England is relatively small, yet as practice and experience have been accumulated it is reaping dividends considerably out of proportion to its efforts by any other standard. A very large amount of credit is being given to the AAF for its part in diminishing the submarine

threat through action against the submarine bases and at an almost ridiculously low cost. As a result of combat team training, and over-all efficiency in all other respects, American bomber forces operating over Europe have accomplished results so great as to cause disbelief even among our Allies. Enemy defenses have suffered bitterly at the hands of our bombers, and enemy installations have been destroyed at a minimum of expense. Actually the percentage loss of our aircraft in daylight attacks has been less than the percentage loss of British bomber forces in night attacks. All of this is the result of combat crew efficiency acquired through untiring practice.

Higher echelons of command are described in the chart on page 118.

Bomber Command Aircraft

Airplane types with which the Bomber Command is particularly concerned are the medium and heavy bombers. Medium bomber types include the North American B-25 *Mitchell,* the Martin B-26 *Marauder,* and the Vega B-34 *Ventura.* Heavy bomber types now in operation include the Boeing B-17 *Flying Fortress* and the Consolidated Vultee B-24 *Liberator.*

The medium bomber is very fast and maneuverable, particularly at medium and lower altitudes, having a moderate bomb load capacity and ability to carry at least one bomb of the largest standard type. It has moderate to fairly large range, depending upon the bomb load, and requires only a small operating crew. A considerable measure of defense lies in its speed and capabilities at minimum altitudes. The prime function of medium bombers is in this minimum altitude work, and its sighting equipment is generally designed for maximum effectiveness at low levels. Furthermore, its "defensive" armament, sometimes including many forward firing guns, is planned for coordinated strafing while on the bomb approach. Another point of defense, however, is the fact that the range capabilities of medium bombers are such that they can be generally accompanied by a fighter escort. In some cases torpedo racks are installed on medium bombers, but the AAF is not inclined to favor this development within its own operations.

The heavy bomber is a highly specialized weapon having a function which can be performed by no other weapon, namely, striking the enemy at the very heart of his source of supply. It has a large bomb load capacity, extreme range capability, and very extensive defensive armament which permits it to operate quite successfully without fighter escort. This is particularly true *in formation flying where a mutually defensive fire pattern can be set up against attacking enemy fighters.* The heavy bomber is capable of extreme altitude, a characteristic which has value in view of anti-aircraft activity and also provides height that may be required to give the bombs sufficient impetus to penetrate well-armored targets. The matter of altitude for defense requires a considerable qualification, however, and will be discussed later.

Two other principal types of bombardment aircraft—dive bombers and light bombers—have their principal function in the Air Support Command and hence will not be discussed in this review of Bomber Command activities.

Bomb Sights

The Americans have unquestionably outstripped everyone else in the development of a bombsight. The efficiency of our bombsight is in line with the Air Force's over-all doctrine of efficiency. The mechanical imperfections of the bombsight are extremely slight; when it is aimed and operated correctly, the dispersion is less than 4 mils. In other words, when bombing from an altitude of 10,000 ft., something less than 40 ft. of the bombing error will be due to the bombsight. All other error would be due to incorrect air speed and altimeter indications and of course to human error in handling the bombsight and airplane. Proper operation of the bombsight requires a straight run of at least 45 sec. on the bombing approach. During this time practically nothing can be done to avoid anti-aircraft fire or fire from attacking airplanes. It is found, however, that this apparent disadvantage is offset by the fact that by the time anti-aircraft guns are tracked to the flight path and by the time the A-A projectile reaches that particular spot, the bomb run is completed and the plane can change its course.

Bombs

In the AAF Bomber Command, efficiency applies right down to the bomb itself. Assuming it is desirable to have the bomb land where it has been directed, (and direction factors are subject to enough ramification) the least we can expect is to have the bomb follow a true course. The principal influencing factor is design of the projectile; and in bombardment ballistic efficiency is very closely allied with aerodynamic efficiency.

Emphasis has been placed by the Americans on aerodynamic efficiency of bombs, a field of development which has been ignored in varying degrees by foreign powers. Many foreign bombs are adaptations of artillery shells and are not specifically designed for their mission. Most of them have cylindrical fins with a minimum of side flat plate area, which the Americans have found to be necessary for true flight characteristics. In copying artillery shell construction, the differences in impact conditions have not been taken into account. The result is considerably less effectiveness in demolition per weight of bomb and an innerent state of unbalance that renders proper placement virtually impossible. Artillery shell design permits but half the explosive content contained in American bombs of the same size.

Bomb Types

There is a great variety of bombs available for employment in air bombardment—each type having a specific purpose. It must be remembered, however, that *complexity of supply problems increases in direct proportion to the number of types employed, and therefore this number should be kept to a minimum.* Furthermore, experience is demonstrating that many special types are not sufficiently effective over standard types to justify their employment.

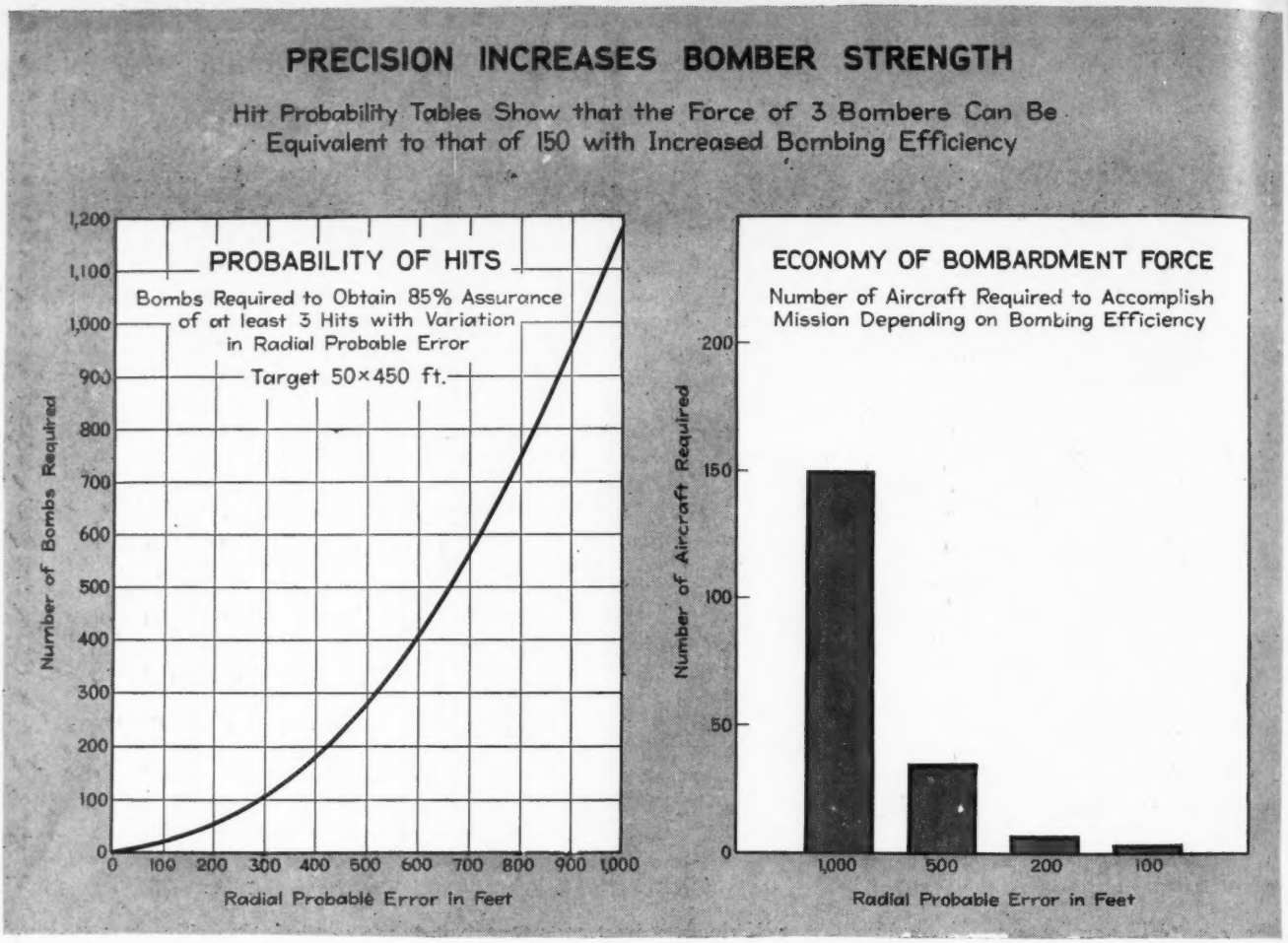
Two principal factors in making bomb type selections are case durability and explosive content. The bomb case will determine utility and relative effectiveness, which are particularly exacting in demolition bombs intended to destroy by force of explosion alone. It is of specific importance that the bomb case remain undistorted and unruptured until the time of explosion. If the case is ruptured upon impact, a considerable reduction in explosive force will result, especially if the bomb is fused for delayed action, even to small fractions of a second.

Most widely used by American forces are "general purpose" bombs ranging from 100 lb. up. Here, the case is made from sections of heavy gage seamless steel tubing, with reinforced nose and tail walls. It will stand up under impact against armor of moderate thickness, such as in the upper two or three decks of a battleship, after being dropped from present maximum practicable altitudes.

Another type is the "armor piercing" bomb, constructed along the lines of artillery shells and designed to withstand impact with very heavily armored decks and installations after falling from altitudes of 40,000 ft. and higher.

The armor piercing bomb contains not more than 30 percent of its total weight in explosives as compared with 55 percent for general purpose bombs. This fact, coupled with other practical shortcomings, opens their general employment to question. For example, bomb impact velocities, even from the highest altitudes, are not comparable to artillery projectiles; in fact, present limitations in aircraft prevent obtaining sufficient altitude to give bomb velocities needed to penetrate structures stronger than those which can be destroyed by general purpose bombs.

Compromises between the two types



in the form of "semi-armor-piercing" bombs are being employed experimentally, but for the present the general purpose bombs have the best all-round utility value.

Bomb Fusing

Bombardment effectiveness depends upon control of both the time and place of the bomb explosion. The ultimate in destructive efficiency is where a static charge is placed by hand and the explosion timed by manual fusing or by electrical control. While such efficiency cannot be obtained by aerial bombardment, the AAF attempts to approach that degree of efficiency in so far as possible. This involves the fusing of bombs which controls both the penetration and time of the explosion.

There are three principal conditions of bomb explosion with respect to time, and all three can be controlled by appropriate fusing. In order to obtain a lateral blast effect to damage a number of structures around the point of impact, the bomb may be fused to explode at the instant of impact without any penetration at all. In the case of fragmentation bombs, it may be desired to have the bomb explode before impact. This can be accomplished by extending the fuse to anywhere from 6 to 24 in. in front of the bomb and to have the fuse ready for instantaneous contact explosion. The fuse may be arranged to cause explosion of the bomb anywhere from 1/50 sec. to a matter of days after impact.

This flexibility of action is of prime importance to bombardment. A demolition bomb explodes with maximum effectiveness when it is tamped in either earth or water, or otherwise confined to space. Therefore, a target can be most effectively destroyed if the bomb is made to explode inside the target or directly alongside.* This is where fusing plays an important part because the time of penetration must be calculated as closely as possible. In operation against a surface vessel, for example, the attacking force must use its bombs so that they will explode only after a time interval sufficient to permit the bomb to reach well into the ship's interior. This may amount to 1/50 sec. or 1/10 sec., depending upon the armor protection of the deck.

Bombs may be employed against submarines if there is sufficient fusing delay to permit the bombs to sink to a depth approximating that of the submarine. If ships are anchored in shallow water, their bottoms may be ruptured by dropping delayed action bombs alongside and having them reach the harbor floor before exploding, thus releasing the force of explosion directly against the relatively thin bottom shell of the ship. In such instances, delays varying from 4 to 45 sec. may be desirable.

It is felt that the effectiveness of instantaneous lateral blast is very much exaggerated and may lead to error in bomb and fuse selection. The critical radius of destruction caused by blast decreases very rapidly, and in many instances greater effect can be obtained by using a number of properly fused smaller bombs to destroy an objective than to rely on the effects of a large blast. The British 4,000-lb. "block buster" is a large bomb with a relatively thin case which is easily ruptured upon impact and depends for its effect upon instantaneous blast force. By simple physical laws, the radius of destruction of a 4,000-lb. bomb will not be twice that of a 2,000-lb. bomb. Actually the explosion of two 2,000-lb. bombs separated by a distance not less than twice the destructive radius of either bomb will cause destruction over a much greater area than the 4,000-lb. bomb.

If the bombs are standard and of good aerodynamic characteristics, the placement of two such bombs in such manner is easily accomplished merely by timing their release. It would seem more desirable practice, therefore, to

determine the minimum size of bomb which, when properly placed by precision bombing, will destroy the target —then to use as many of these bombs as may be required. Actually, the total bomb load requirements would be considerably less than if oversized bombs were used.*

It should not be construed from the foregoing, however, that 4,000-lb. or even 8,000-lb. bombs do not have their place. For example, one of the finer tactical points is the knowledge that a 4,000-lb. bomb may be a good thing to use in settled areas *in the wintertime*, not so much for its demolition effect as for its window shattering effect. Incidentally, the term "block buster" should be interpreted with caution. Some American reporters have taken the term literally and have written that such bombs could wipe out an entire city block. The British do not employ the word "block" as we do; they usually use it in the expression, "block of flats", meaning an apartment house. A direct or alongside hit by a 4,000-lb. bomb might well destroy an ordinary apartment house, but a direct hit from a 2,000-lb. bomb would probably do the same!

* "If the explosion occurs within a building or other confined space, the resulting damage will be much greater (than in open air). This is due both to the increased blast pressure produced by the confined space and to the reflections of the pressure from the surrounding surfaces. In general, the more resistant the walls of a building, the greater the shattering and destructive effect of the explosion. . . . Since the more a high explosive charge is confined during its detonation the greater will be its shattering and destructive effects, *direct hits with even small demolition bombs are immeasurably more destructive than near hits with considerably larger bombs.* And particularly is this true when the bomb penetrates into the target before exploding."—Lt. Col. A. M. Prentiss, U. S. A., p. 35, *Civil Air Defense.*

In addition to demolition and fragmentation bombs, the bombardment command employs three different types of incendiary bombs. Two of these are thermite and magnesium bombs, which produce intense heat in a relatively small area. Magnesium burns with less intensity than thermite. The third type of incendiary bomb is the oil bomb which uses oil or thickened gasoline as a burning agent. The intensity of heat of these oil bombs is considerably less than thermite or magnesium, but its burning area is decidedly greater. The flow of oil upon bursting makes this bomb a very effective weapon. It is particularly destructive when it burns around machines where heat can do much more lasting damage than that caused by blast effect from demolition bombs.

Bombardment Philosophy

Before going into the tactical employment of these tools, it is well to outline the philosophy of employment which is based on the availability of the tools, and which, on the other hand, has led to their development.

War efficiency, like any other kind, involves the securing of maximum result at minimum expense. It is an unquestionable fact that minimum manpower expense in war is a direct result of training. Therefore, whether or not it is carried out to the ideal degree as a practical matter, perfection through training is a basic goal of the Army Air Force.

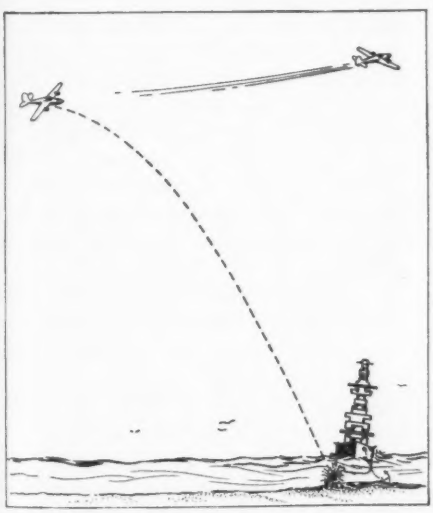
Stated simply, the efficiency objective of a bombardment mission is to destroy a target as completely as possible with a minimum expenditure of men and material. Fulfillment of the bombardment mission involves getting to the target, which is a factor dependent upon aircraft design, and destroying the target, which involves *hitting it* with properly chosen explosive agents. There are two principal methods of scoring hits on a target: One is to saturate the target area with masses of bombs with the knowledge that in so doing the target is bound to be destroyed; the other is to obtain a proper sighting of the target and to hit it with all possible precision. The latter method is certainly the least expensive in terms of bombs required and in terms of mission aircraft requirements. In fact *it is exactly what all contestants in this war would do if it were within their power to do it!* This is a fair assertion because all have tried, and all but the Americans have failed.

Others failed because in attempting daylight bombing where the target could be sighted, they could not accomplish their missions without exorbitant cost in aircraft crews through fighter defense activity. Until the heavily armed American bomber appeared on the scene, daylight bombers extending beyond the range of fighter escort could not defend themselves against enemy fighter attack.

And here is a peculiar commentary on the ways of men and nations. Pick up any basic manual of war, or review mankind's conflicts since history was written. You will find that the fundamental axiom is that in any fight, whether between two people or two nations, the primary object of either side is to *compel the enemy to cease resistance. If this is accomplished, all other general purposes can be realized.*

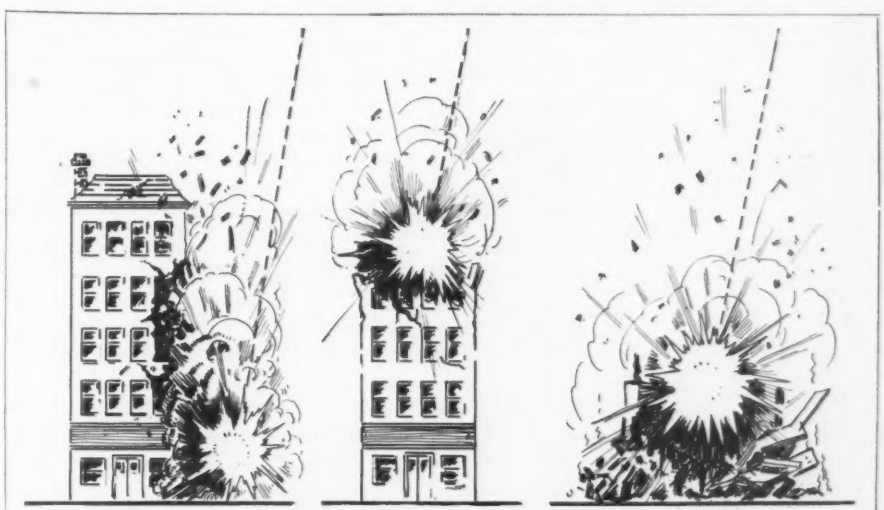
Analysis of any conflict will show that success or failure depended on whether

(*Turn to page* 338)



Sinking a Battleship at Anchor

A bomb, properly fused for delayed action and dropped alongside a ship at anchor, will explode after sinking to the harbor floor, causing force to be directed against unarmored ship bottom. This is far more effective than dropping bombs on protected topside.



What Precision Bombing Will Do

A near miss will do only limited damage, hence a number of near misses are required to destroy the target. Too short a fuse, or instantaneous explosion upon impact, will only do local damage even if a direct hit is made. Precision bombing involves not only hitting the target but causing the bomb to explode at the proper place within the target. Complete destruction is then assured at minimum expense.

Our Planes and Our Peace

By HARRY WOODHEAD
President, Consolidated Vultee Aircraft Corp.

A realistic look into the future offered by a leading manufacturer who not only sees joint problems for producers and transport operators but also has sound methods for their solution.

As we enter the offensive stage of this war it behooves all manufacturers of airframes, engines, and accessories and all air transport operators to take a more active interest in the problems which we are all bound to face when peace comes.

It is inconceivable that we should be no more prepared for the peace than we were to meet the sneak attack at Pearl Harbor which began our participation in war.

While it is essential that all of us should devote the bulk of our energies to the war effort, at the same time it becomes apparent that if we do not begin to take part in all of the postwar phases of our industry, the recession which we are bound to face will be serious. Its length, depth, and nature can to a great extent be controlled by our preparedness, our enterprise, and our aggressiveness.

Problems for All Industry

The destinies of both aircraft manufacturers and air transport operators are definitely interwoven. A survey of current and future problems reveals that there are some which both groups face equally. Again, there are those which most directly face the manufacturers and those which most directly face the transport operator. But all these problems are interlocking.

One of the outstanding issues facing both is the loose talk of government ownership or government partnership in all aviation activities. Through the Defense Plant Corp., the government has a huge stake in manufacturing. Through policies which have been formed, are being formed, or are being discussed, certain government agencies are showing a definite interest in subsidizing or controlling international airlines.

The reason why the government is so heavily interested financially in aircraft manufacturing plants is obvious. As war clouds grew and became more ominous, it was apparent that the youthful aviation manufacturing industry did not have the funds or the facilities to produce the enormous number of planes needed, with the utmost speed, by the United Nations to battle the Axis on all fronts. Financial help was required, and the government was wise enough to understand this and step in.

The move on the part of the government, in the face of an emergency was astute. Our present vast plants, our mass production, and the ever-increasing monthly totals of airplanes delivered to our armed forces prove this. But remember that this constituted a dire emergency.

At the end of the war the emergency will cease to exist. It must be noted that while government funds were supplied, design and production—the total operation of the industry—continued to rest in the hands of men who had had the "know-how" after years of pioneering under a system of free enterprise. Without our Curtisses, Wrights, Martins, Fleets, Vultees, and Douglases, just to mention a few of those rugged, two-fisted fighters, all the money in the world would not have given us our present output of quality aircraft which, through design, manufacturing methods, and performance are again and again proving their superiority over the enemy all around the globe.

As the emergency passes, the sum total of the knowledge of all these and other aircraft and engine producing organizations must not be lost, nor must it be submerged under government ownership or government partnership. We will have an emergency after the war, but it will be of a very different type—it will be an emergency born of competition, and will call not for great sums for expansion but for economy and efficiency for both manufacturing and operation.

Interference, hindrance, or even a partial voice in management by the government would of necessity destroy these essentials. In the case of transport operations, it is only necessary for me to recall the terrific expenses incurred when the government operated the airmail in the early days following its inception, and the economies brought about by operation by private concerns under a system of free enterprise. I might also mention the debacle which occurred in the '30's when the Army, on short notice, was ordered to fly the mail.

If aviation is to continue to make strides in the future to satisfy the demands of an airminded world, it cannot be hamstrung. Aircraft manufacturers have proved themselves, not only during this war but also in the 35 yr. of struggles, setbacks, and rebuffs which preceded it. Greater safety, lowering of air express, airmail, and passenger rates by privately owned and operated air transport companies are all written into a glorious record of achievement. Government operation of industry, even in the isolated instances in which it has occurred in the history of this nation, has proved far from satisfactory. An outstanding example in the field of transportation is government operation of the railroads during the last world war.

Renegotiation Policy Needed

Of the obstacles faced by manufacturers, an outstanding one is the current renegotiation of contracts by the government. As aircraft manufacturers pass over the peak of their production of military aircraft and begin to taper off when peace looms some time in the reasonably near future, several projects must be under way. Designs should be perfected and plans for production should be started. New designs should be projected, tested, and made ready for immediate production. These new airplanes must be designed so that they can be built and maintained at lowest possible cost, and can offer suitable performance for the uses to which they will be put. Military refinements and developments must be adapted to commercial use.

My point here is that aircraft manufacturers must be getting under way in the very near future to accomplish these goals. The longer they are delayed, the longer and deeper will be the recession. And they cannot get far with these essential projects without adequate financial reserves. Renegotiation of contracts, provided for in the Revenue Act of 1942, is now being applied in such a way that many "growth" industries, including our own, are not being permitted to build up adequate postwar funds. I do not believe that this was the intent of Congress. I believe renegotiation was designed to limit such huge war profits as were made in some instances in 1917-1918.

What makes the situation doubly bad is that while growing industries are threatened with being stifled, mature industries are permitted to acquire greater strength. In the past, industries have been born and have grown to maturity without paying tribute which would rob them of that growth. In the field of transportation the stage-coach, the canal boat, the railroad, and the automobile developed in succession, each being rewarded by profits in accordance with merit. That is the American way.

But now a law is threatening to bar aviation manufacturing and numerous other growth industries from taking advantage of their natural opportunities.

This is the way contract renegotiation affects the aviation industry:

When large contracts were first let, manufacturers, unaccustomed to dollar volume running into hundreds of millions, were unable to estimate their production costs accurately. At that time, the peak excess profits tax was 65 percent. With manufacturing efficiency cutting costs sharply, producers would have reaped large profits. However, now that costs have been well-established and the excess profits tax rate reaches up to 90 percent, contract renegotiation as now set up has outlived its usefulness.

The growth industries are especially penalized under renegotiation because capital invested wisely or unwisely in the past or former earnings are the standards on which profits to be allowed are based. Such factors as operating efficiency and tremendous volume of sales with the financial risks they entail are lost in the mazes of taxes and contract renegotiation. Many companies in mature industries are making large profits from wartime activity by virtue of expansion which took place years ago.

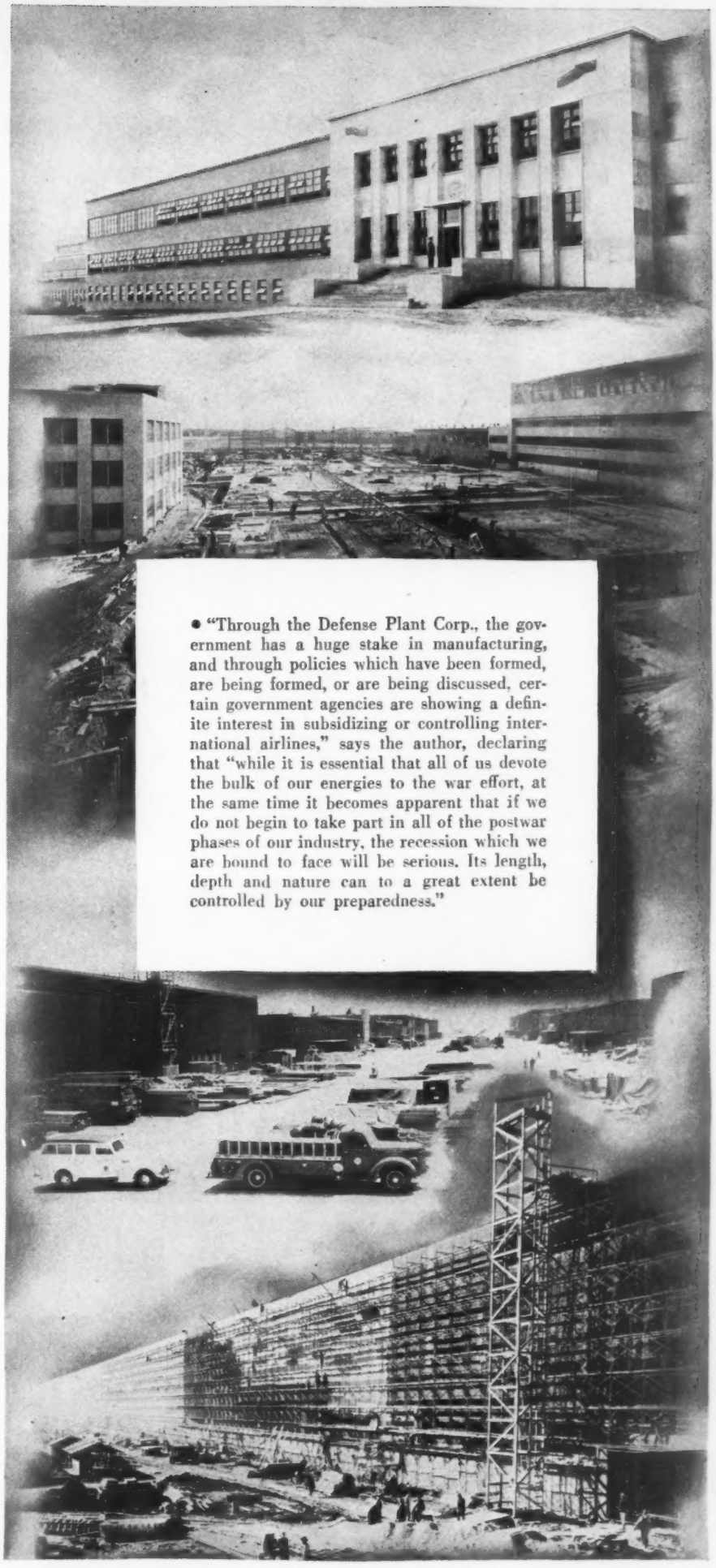
As for the aircraft manufacturers, if they continue to be taxed and renegotiated at the present rate, the technological advances which have been accomplished may be lost, with the production end of the industry settling back into the doldrums in which it wallowed for two decades. The know-how which we have achieved could be lost to a peacetime world clamoring for air transportation.

What About Surpluses?

A third issue in which aircraft manufacturers should take an active current interest is the governmental attempt to decide an equitable means for the disposal of surplus aircraft after the war. Already a Federal Surplus Aircraft Corp. is proposed. Among the questions which must be faced are:

Shall certain aircraft be destroyed or dismantled? Shall they be returned to

(*Turn to page* 333)



• "Through the Defense Plant Corp., the government has a huge stake in manufacturing, and through policies which have been formed, are being formed, or are being discussed, certain government agencies are showing a definite interest in subsidizing or controlling international airlines," says the author, declaring that "while it is essential that all of us devote the bulk of our energies to the war effort, at the same time it becomes apparent that if we do not begin to take part in all of the postwar phases of our industry, the recession which we are bound to face will be serious. Its length, depth and nature can to a great extent be controlled by our preparedness."

BUILDING THE AAF
PART I

Pre-Flight Toughens 'Em

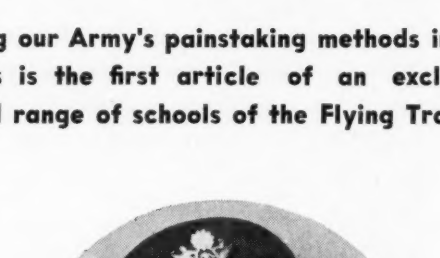
Revealing our Army's painstaking methods in shaping its "green" cadets, this is the first article of an exclusive AVIATION series covering the full range of schools of the Flying Training Command.

By MAJ. GEN. BARTON K. YOUNT

SINCE THE Army Air Forces Flying Training Command was first inaugurated, its activities and responsibilities have expanded at such a rapid rate that to tell its complete story would require adding a new chapter almost daily. Some of its activities naturally cannot be told until after the war; others may, and should, be told today.

It is important that the people of America be kept abreast of this work. For, after all, the function of the Flying Training Command—indeed its only reason for existence—is to prepare for combat the thousands of pilots, bombardiers, navigators, and gunners who will fly our planes against the enemy.

We're all Americans working together to maintain and preserve forever this country's cherished ideals. And America may well be proud of the network of training schools which span the nation from coast to coast—a program so vast that it is almost impossible to visualize.



Maj. Gen. Barton K. Yount

Commanding general of the AAF Flying Training Command, Gen. Yount directs our Army's broad program of developing thousands of pilots, bombardiers, aviators, and gunners. His headquarters are at Fort Worth, Texas.

But progress comes not with the size of an undertaking but with the thoroughness with which it is carried out. Modern warfare teaches its own lessons—lessons that cannot fully be learned in noncombat flying or desk-top theorizing. Therefore we endeavor never to cease introducing valuable war-born ideas and techniques into our training curricula. We think it significant that at each of our scores of schools, executive personnel, instructors, enlisted men, and (in some cases) students have developed more efficient ways in which to do the job.

Recent important moves have included establishment within the Flying Training Command of central instructors schools to standardize and improve instruction in flying, gunnery, and bombardiering. These new schools serve not only as places of learning, but as centers of experiment and discovery.

Transitional flight training also is experiencing a major expansion. Recently activated schools are readying large numbers of pilots who have already won their wings for service in tactical four-engine and twin-engine aircraft. These men will reach the operational training units in a far more advanced state of training than was possible in the early days of the flying training program.

The Women's Pilot Training Program, which is under this Command and is directed by Miss Jacqueline Cochran—herself proof of the fact that women do have a vital place in aviation—is proving a valuable adjunct to our activity and has opened another important field in which women may serve their country. Graduates of this training are being called upon to do noncombatant flying within the United States for the Air Transport Command. A high degree of efficiency has been noted in the work of those assigned to training in the first classes.

Another valuable step has been taken in the initiation of a plan to produce men qualified in three different tasks of the bomber crew. Graduates of this course will be skilled avigators, bombardiers, and gunners, ready to perform

To test their reactions at high altitudes, aviation cadets at Flying Training Command preflight schools get simulated sub-stratosphere flights in pressure chamber. This is one of many techniques developed to speed training—without quality compromise—when cadet reaches flight training stage.

any one of those three jobs in action against the enemy.

These are some of the physical aspects of our program. But our aim is not only to produce men superbly trained in the art of destruction but also to better the man himself. In every school within the jurisdiction of the Flying Training Command, the cadet is made aware of his duties and responsibilities as a gentleman and future officer.

We are proud of what we are doing and are constantly gratified to find, through reports from every theater of operations, that our airmen are doing justice to the program which we are endeavoring to maintain and always to improve. It is these men upon whom the success of our work rests. Without such high caliber material with which to work, our efforts would be infinitely less effective. These men—pilots, avigators, gunners, bombardiers—all have matched their technical proficiency with a reassuring will to give their best at any and all times.

We of the Flying Training Command have confidence in the future, because we have complete confidence in the faith and abilities of those in whose hands the future rests.

★ ★ ★

THERE WAS A TIME when the nation's military pilots were premature aerial children whose birth in the skies came after a sketchy and venturesome gestation with a single, impatient instructor.

That's about how it was in 1918. A stout-hearted teacher let his student look over a *Jenny*. Then he took the uneasy youth aloft, for a total of hours easily counted on one hand, and finally said "Take 'er up alone, bud". True, a lot of wings were clipped and a lot of props and nerves were cracked—but out of it all emerged a warbird who made up in courage what he lacked in experience and knowledge.

The *Jenny* was a simple airplane. It didn't take much book-learning to handle. Usually, the seat of one's pants was sufficient guidance. It had to be, for instruments were scarce and were far from being the precision units of today. The aviation textbooks which now fill the shelves in any library were still to be written. The man-flyer has come a long way since World War I.

That's why you can't take just any kid from high school or college, walk him over to a 1943 fighter plane, and *talk* him into being a good pilot.

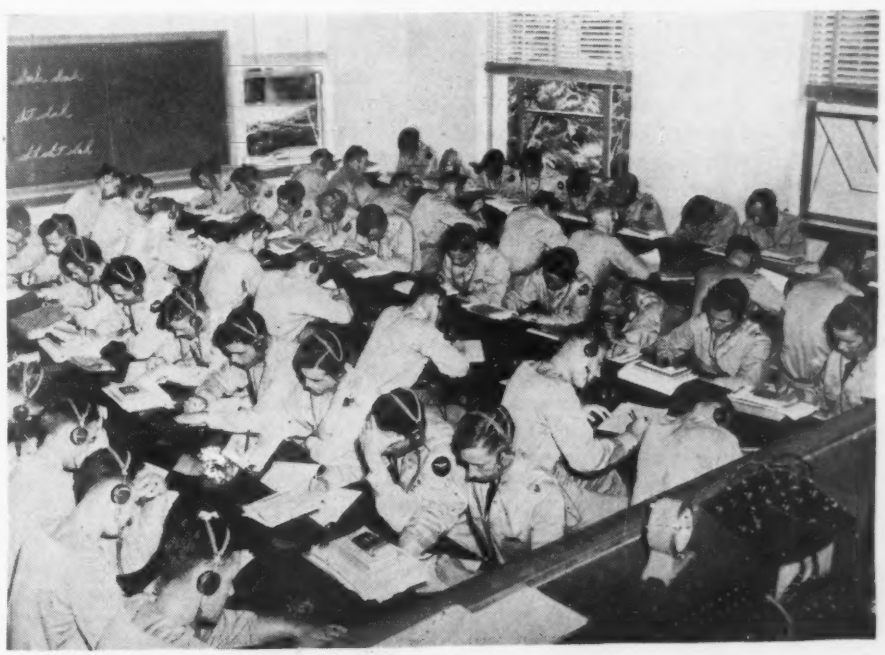
To fly a fighter or bomber, or to avigate or be a bombardier, today's U. S. Army Air Forces representative must be a technician with a "degree" from the world's most elaborate system of aeronautical education. If he isn't, then his equipment, and not he, will be the "boss" when the chips are down in combat.

Only way pre-flight cadets get into air is by pulling themselves up hand-over-hand. But during the nine weeks, the rigorous training prior to assignment to advanced schools toughens future air crews for long grinds of modern air missions.

It's no simple task—this assignment of inculcating in America's typical young man all the "feel", all the theory, the ideas, and the practice assembled during a generation of experimentation by history's most fertile aviation minds. And even when all that has been done, there still must be something inherent in the man that sets him apart from his fellows as one with that inscrutable gift for sensing the right thing to do, at precisely the right instant, in a lightning-fast warplane.

This victory-vital job is being done by the AAF Flying Training Command, administrative unit of a far-flung chain of schools. Because there are certain

(*Turn to page* 321)



AAF pre-flight cadets' days are long and arduous, including full share of classroom work. For instance, there are radio code studies (above) from which cadets sometimes emerge temporarily "dat-happy."

Are YOU Prepared For Contract Termination?

By RAYMOND L. HOADLEY
Financial Editor, "Aviation"

What's more, is the government prepared? Fact is that cancellations —already recorded in some lines—are now closer to aircraft producers than is generally realized. Here are some of the industry's suggestions which can prevent the chaos of interminable litigation.

IT IS LATER than you think for the government and industry to plan the orderly termination of contracts for production of war materials.

Already the War Department alone is cancelling supply contracts of greater dollar value than all the war contracts cancelled at the close of World War I. True, there have not yet been many cancellations in aircraft—but it can now begin to happen even here.

In 1918 the War Department did not adopt a standard termination clause until six weeks before the end of the war. And even with the adoption of this standard clause, many different termination clauses and bases were used in effecting settlements. The Dent Act to give relief for damages suffered under defective contracts was not passed until Mar. 1919.

More than 12,000 claims had not been liquidated nine years after the war. Some 3,000 contractors, according to Clarence L. Collens, president of Reliance Electric & Engineering Co. and one of the foremost contract termination authorities, were forced to seek relief in the Court of Claims alone. Settlements there took an average time of three and one-half years. Some were never settled.

In the last war settlements averaged about 13c. on each dollar of cancellation. A chemical company's claim of $24,500,000 with a "clear guarantee against loss from termination" resulted in a $19,000,000 compromise after dragging over two and a half years. A steel company's claim of $12,000,000 required 24 yr. for final settlement.

With industry's experience in the other war haunting them, plane makers fear that it may be twice as hard to get out of war work as it was to get in. They do not have any "letters of intent" or blueprints on getting out.

The aggregate value of contracts that will be outstanding at the cessation of hostilities is variously estimated from 75 billion dollars to 125 billion. The 7.5 billions outstanding at the end of World War I were peanuts in comparison—though they loomed large at the time.

Then there are many times the number of contracts, subcontracts, and subsubcontractors. Naturally so, as this is ten times as costly a war. There are around 100,000 contractors and at least 1,000,000 subcontractors.

No wonder, then, that foresighted aircraft executives are beginning to prepare for termination. Will the legal wrangling over contract cancellation prevent the release of large sums of money needed for postwar production? This is a real concern to those officials who are striving to get the government to establish definite rules for the wind-up of war contracts.

The aircraft industry can't wait three years, or even three months, for that matter, to settle the bulk of its contracts after the war. This new industrial giant has had no opportunity to build the reserve cushions that the automotive and steel industries, among others, enjoy.

Consider, for example, the year-end financial statement of Glenn L. Martin Co., indicating a weekly payroll of 1.7 million dollars. Four weeks of this payroll would wipe out Martin's 1942 net profit. A Consolidated Vultee Corp. official recently told a Congressional committee that his company had cash funds to meet payrolls for only two weeks should war work suddenly cease. Lockheed Aircraft Co. reported a 4.8 million dollar weekly wage liability at last year-end, enough to wipe out its 1942 earnings of 11.6 million dollars in less than three weeks.

Funds Vital

It can easily be seen that the postwar employment of thousands of aircraft workers revolves around the problems of contract termination. The industry must immediately obtain funds due on war contracts to permit reconversion to civilian production.

Experience so far on contract cancellations shows that settlements are long drawn out, with the contractor usually holding the bag. One hears this account of a Midwest company whose $6,000,000 contract was cancelled: The government auditors arrived three months later to check the records. Then additional time was needed to audit the books of 20-odd subcontractors. Final settlement had not been made at the end of six months.

The Ordnance Department, in terminating contracts, has made approximations of company claims and made payments on half the amounts. The balance has been subject to negotiation and auditing before disbursement. Aircraft makers, however, feel that a 90 percent cash payment should be granted where companies have a good credit standing if a tie-up of the industry's working capital is to be prevented after the war. Furthermore, they point out, "fly specking" on audits should be eliminated in favor of the sampling method used by accountants in checking inventories and costs.

Point to Poor Accounting

Federal officials come back with the retort that they have been hampered by a lack of modern and uniform accounting systems in many plants. This, they explain, makes unavoidable a minute and careful check.

One basic need is a standard clause for termination of contracts. Almost every aircraft or parts manufacturer is working on a variety of contracts for different branches of the government. Unless a uniform method of termination is determined upon, he will have to deal at length with nearly as many government contract cancellation experts as he has contracts in his shops. His V-loans (if he has any) will be of little aid, as all incoming funds will go to his bank until the V-loans are cleaned up.

Government men may decide that his inventories are too large. Perhaps he may be retooling for a new model when termination comes. The corporation with 300 or more subcontractors may well wonder about their cancellation status. Unless procedures in all these matters are standardized and simplified the accounting problems may exceed the capacity of the industry's accountants.

Thus the problems that will arise over termination are legion. Frequently, as Dundas Peacock, a prominent termination specialist, points out, the govern-

(*Turn to page* 312)

Needed... A Plant Re-Conversion Cost Policy

By H. L. FEDERMAN

Straws in the wind, bearing also on renegotiation and termination, indicate manufacturers must provide initiative in rule setting.

FIRST, an accent or two on contract termination before gaging the broad perspective of re-conversion:

While military strategy is based on the premise that the war will continue well beyond next year, considerable concern is becoming evident regarding sudden termination of military contracts before their completion. According to an Army Service Forces officer, a large number of war contracts have already reached termination status: other sources place the number of contracts that may be cancelled in the nine-figure bracket, totaling possibly $100,000,000.

With scheduled production of $20,100,000,000—a fourth of the entire war budget for 1943—the aircraft industry undoubtedly has the most weighty interest of all in terminations. But closely allied with terminations, (discussed in detail on page 126) and perhaps as important, are the inter-related problems of contract renegotiation and plant re-conversions.

Every time a contract is renegotiated, the company concerned is affected as to its position on the day when hostilities finally cease and, accordingly, its ability to make the transition to a peacetime economy. Any rules currently drawn as to the form of contract termination can hardly ignore current practices attending renegotiation. Official statements and the few available case histories give some clues which deserve close examination by the industry.

By way of example:

Speaking in Boston before the annual convention of the National Association of Cost Accountants, a spokesman for the Office of Fiscal Director, Army Service Forces, advanced one of the first indications as to the procedure to be followed in negotiating termination of war contracts before their completion.

Confining his statements largely to those elements which enter into cost determination, the speaker itemized four factors which would be taken into consideration: These were: The prime contractor's total cost, his portion of profit applicable to the incomplete part of the contract, the claims of his subcontractors, and costs incurred by the prime contractor subsequent to termination of the contract.

Allowable are overhead cost items, which should, however, be arrived at by employing the same method consistently throughout the period for which that cost item is being figured, and which should contain statements and estimates "susceptible of check." Also allowable are costs of special equipment, tooling, and wartime obsolescence or depreciation. Disallowable is the cost of reconversion. Profits for incomplete portions of a contract are to be estimated by invoking a formula which is based to a large extent on past performance.

Thus reconversion costs are "out," which makes it exceedingly important not to be left with incompleted units in process of manufacture. The aircraft industry—with its complex problem of manufacturing large units consisting of a series of subassemblies flowing through its long "pipe-lines" of production—will inevitably find itself with many unfinished planes.

Undoubtedly much more remains in promulgating the final regulations concerning abrupt contract cancellations. It is essential that fair policies be established controlling settlement and which can be accepted by business without unnecessary disputes. On the other hand, government officials maintain private industry must have the proper organization and a fair-minded attitude in expediting all settlements of claims.

Differences Crop Up

Already differences of opinion have developed as to the government policies indicated in this matter. The chairman of the Committee on Auditing Procedure of the American Institute of Accountants has asserted that the cost of re-conversion back to peacetime work is just as much a cost of the war effort as the original cost of conversion from civilian production to war manufacture. Further, payment of severance allowances, which might be necessary in many cases, has also been demanded.

Moreover, the suggestion has been advanced that there should be some right of appeal, other than to the head of the agency involved, in the event that the contractor and the government representatives were not able to arrive at a mutually satisfactory settlement.

A taste of the difficulties encountered through the absence of sound policies is afforded by the experiences attending the recent cancellation of a few government contracts as the Army and Navy adjusted their buying to meet the needs of the battle fronts. While this occurred in other industrial fields, the pattern may be repeated for the aircraft builders in the absence of further clarification.

Industrial contract cancellations in the Detroit area, for instance, have revealed that final settlements are long, drawn-out affairs, leaving the contractor holding the bag for out-of-pocket investments. The subcontractors suffer in a similar manner. Further, stoppage of war production immediately results in too much labor in a concentrated area.

All this adds to the need of accumulating sufficient reserves. And here is where contract renegotiation assumes its dominant role in the entire process.

Proposals have been advanced to adjust the War Contract Renegotiation Law to give due recognition to the special problems peculiar to the aircraft industry and the conditions it will face upon sudden termination of contracts. One suggestion, if enacted, would direct the Price Adjustment Boards to make allowances for postwar reserves.

Basic support for such reserves lies in the contention that for the aircraft builders to survive after the war and to fulfill their mission to commercial aviation and to the country, they must be left with sufficient financial resources. It is strongly contended that the present renegotiation processes and tax laws make it virtually impossible for the industry to retain any substantial reservoir of funds for the future demands to be made upon it.

While the aircraft industry will have available extensive plant and other fixed manufacturing facilities in the postwar period, the group's financial

(*Turn to page* 289)

BARRON'S STOCK AVERAGES

	Aircraft	Air Transports	50 Stocks
July 2, 1943....	33.45	41.53*	82
June 24, 1943...	32.32	37.78	80
June 17, 1943...	32.52	38.25	80
June 10, 1943...	33.50	38.56	81
June 26, 1942...	26.80	17.69	59
June 26, 1942...	34.32	37.94	82

* New high for 1943

We are hard at work on Helicopter Bearing Development

CAN WE HELP YOU?

We now have in development stage a new line of tapered roller bearings for helicopter bearing mounting designs. There is still considerable work to be done but there is enough work behind our research staff at this moment to make intelligent, tentative bearing recommendations, subject, of course, to subsequent refinements.

Furthermore; we have many facts at our finger tips now to make definite mounting recommendations to meet all the different types of helicopter designs that are now evolving. This statement is based on past performance, for Timken has been closely associated with practically every industry during its development years —including the automotive, farm equipment, steel, machine tool, airplane, compressor, construction equipment, in fact over 50 major industries. The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Manufacturing Section of AVIATION

PRODUCTION • DESIGN • RESEARCH • ENGINEERING

Design Analysis of the Curtiss *Commando* ..... ***John Foster, Jr.*** **130**

Super-Aluminum Alloys for Aircraft Structures, I ***Kenneth R. Jackman*** **154**

Cutting Costs on Perforating Dies ..... ***E. H. Ruder*** **165**

Ring Design Makes or Breaks the Engine ***D. M. Smith and Nelson Wainwright*** **171**

A More Efficient Grinder for Carbide Tools **178**

Bell Machine Gun Adapter Raises the Score **178**

Fleetwings Wing Chord Divider Beam **181**

Aluminum Castings Saved from Scrap **181**

Sheet-Spring Fasteners Speed Aircraft Assembly ..... ***Harm White*** **183**

Aviation's Sketch Book of Design Detail

Consolidated Vultee PBY *Catalina* Superstructure.. 187
Exploded View of Cessna AT-17 *Bobcat* 187
Bell P-39 *Airacobra* Wing 189
PBY Engine Nacelle 189
Junkers Ju-88 Wing Fitting Details 191

Aviation's Engineering Data Book

Welding Aluminum Alloys 193

Review of Patents ..... *A. Harry Crowell* 196

Subcontractors Section 203

New Products and Equipment for the Aviation Industry

Information Tips on Trade Literature 233
Latest Machine Tools 237
Shop Equipment and Accessories 239

Design Analysis of the

CURTISS COMMANDO

By JOHN FOSTER, JR., *Associate Editor, "Aviation"*

First detailed engineering reference study of the C-46, our noted combination transport-task force warplane now serving 'round the world, tracing development from prototype to current production model.

QUICK REFERENCE INDEX

Basic design development.....page 131
Fuselage construction details..... 132
Fuselage dimensions 134
Weight data 132
Performance, balance and load data..... 133
Cargo compartment layout..... 133
Cargo compartment data..... 133
Standard instrument data..... 135
Pilots' cabin arrangement..... 135
Wing design development..... 136
Wing data 138
Engine nacelle construction..... 136
Flap data 141
Flap design and operation..... 143
Aileron data 143
Aileron design and construction..... 145
Empennage structure 145
Stabilizers 145
Elevators 145
Fin 145
Rudder 145
Empennage group data..... 145
Landing gear structural details..... 147
Main gear 147
Tail wheel 147
Engine control system details..... 148
Main hydraulic system details..... 148
Electrical system 151
Fuel system 151
Oil system 153

DESIGNED AND BUILT originally as a passenger transport, the Curtiss C-46 *Commando* has been developed into a task force craft which today is more than "doubling in brass" as a wartime cargo carrier.

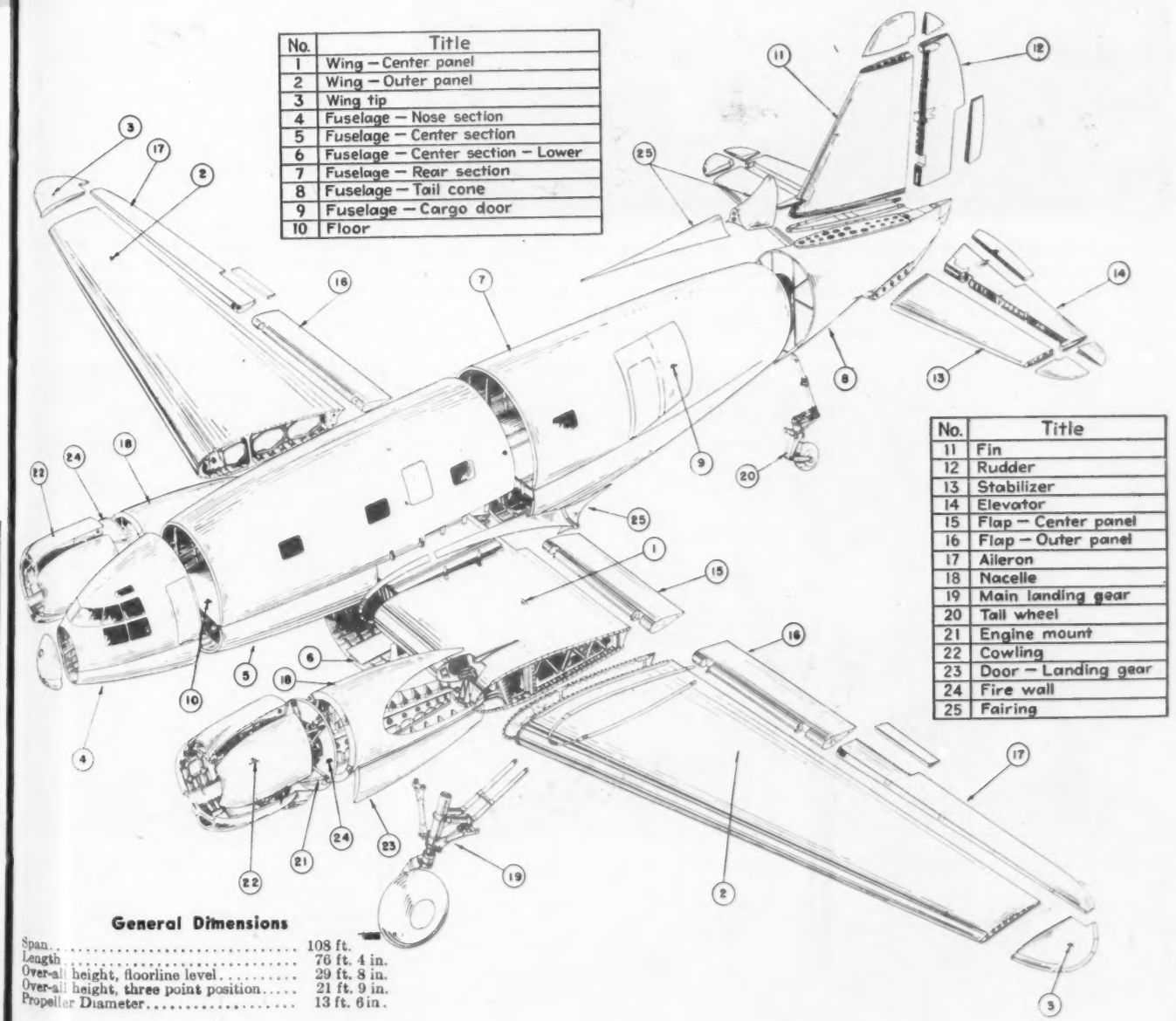
Serving as it is in every war theater, the C-46 offers an outstanding example of what can be done with a large twin-engine craft—the largest of its type in the world—designed primarily to move the most material at the lowest possible ton-mile or man-hour cost. The vast operational know-how being swiftly acquired under wartime pressure is providing an unusual back-log of design, operation, and maintenance experience for postwar utilization.

Basic design of the *Commando* was crystallized in 1936, following three years intensive study aimed at producing a design which would result in an airplane that would make the operator the most money. Curtiss-Wright engineers, under Chief Engineer (now Director of Engineering) George Page, reasoned that the best way to get repeat orders was to give airline operators just such a plane. On the basis of conversations they planned to build 25 units of the CW-20—the C-46's predecessor—but tooled for 50, banking on repeat orders. Though 50 planes of its size was a tremendous undertaking in those days, it is but a small part of current monthly production schedules.

The late Eddie Allen and Chief Engineer George Page just before first test flight of the CW-20, prototype from which the C-46 *Commando* was developed.

One of the major points in the preliminary design study—cabin pressurization for sub-stratosphere flying—resulted in the *Commando's* unusual fuselage design.

In cross section the fuselage, except for the extreme aft portion, is formed by two intersecting circles with the common chord of intersection as the cabin floor line. A circular section was decided upon, of course, because it is ideal for pressurization. However, one circle for the size airplane involved would have presented excessive frontal area that would greatly reduce aerodynamic efficiency. But by using the *two* circles, frontal area was reduced without losing the ideal pressure section, and the common chord line serves the dual purpose of tying the circles together and providing the floor structure. Flush riveting

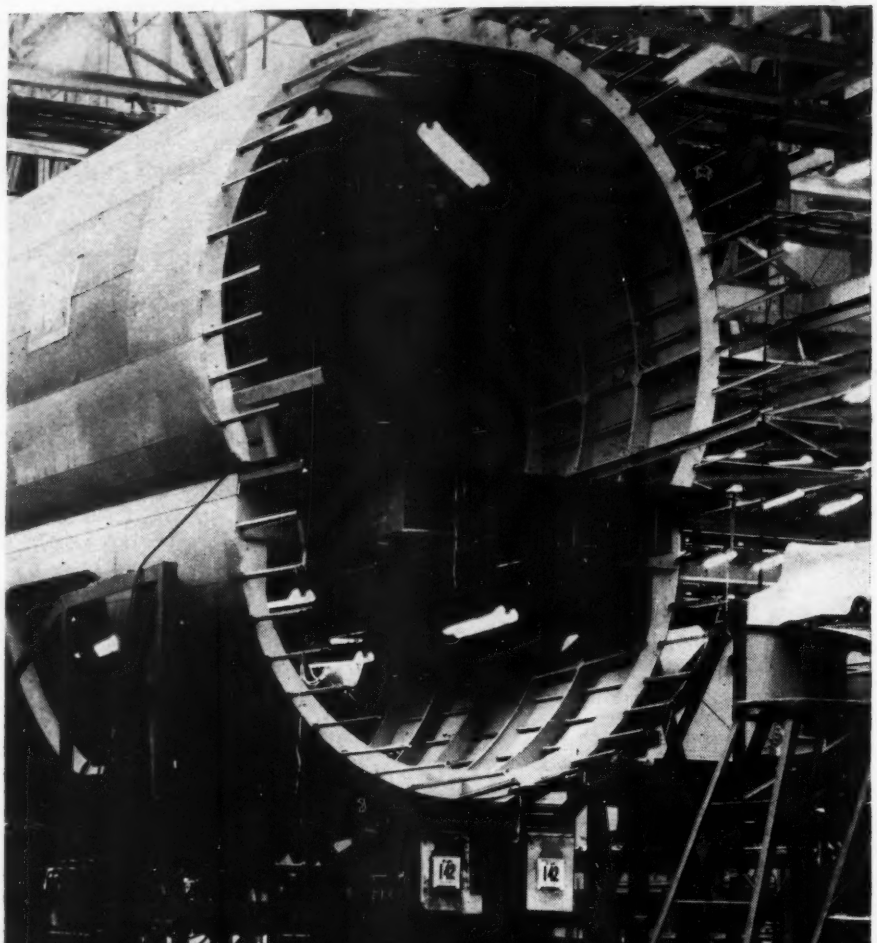


No.	Title
1	Wing — Center panel
2	Wing — Outer panel
3	Wing tip
4	Fuselage — Nose section
5	Fuselage — Center section
6	Fuselage — Center section — Lower
7	Fuselage — Rear section
8	Fuselage — Tail cone
9	Fuselage — Cargo door
10	Floor

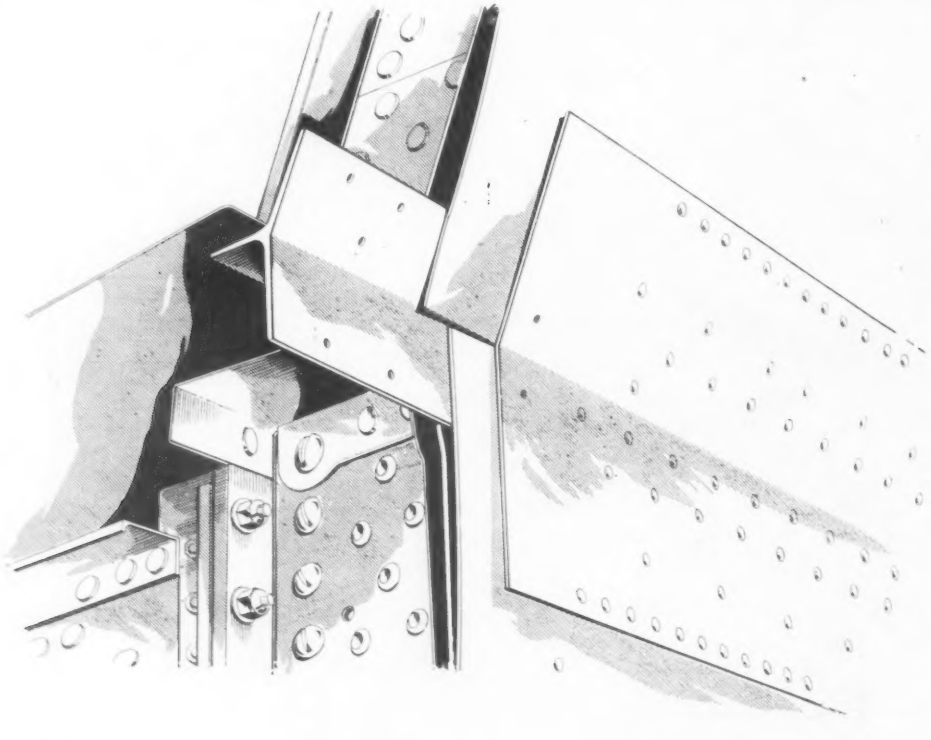
No.	Title
11	Fin
12	Rudder
13	Stabilizer
14	Elevator
15	Flap — Center panel
16	Flap — Outer panel
17	Aileron
18	Nacelle
19	Main landing gear
20	Tail wheel
21	Engine mount
22	Cowling
23	Door — Landing gear
24	Fire wall
25	Fairing

General Dimensions

Span	108 ft.
Length	76 ft. 4 in.
Over-all height, floorline level	29 ft. 8 in.
Over-all height, three point position	21 ft. 9 in.
Propeller Diameter	13 ft. 6 in.



Cross-section of C-46 fuselage just behind pilots' cabin (above) shows unusual construction—two circles with intersection at common chord line formed by cabin floor separating main and lower cargo compartments—designed to provide ideal structure for cabin pressurization without presenting excessive frontal area. Detail sketch (below) illustrates method of tying together circular segments through beams which serve additional function as main cargo compartment floor supports.



is used in the "drag sensitive" area of the fuselage (as well as leading edges of wing and empennage surfaces) with modified brazier head rivets on other parts of the surfaces.

In the prototype, it will be remembered, the two-circle structure was not apparent because fairing between the outside diameters of the two circles gave the craft an elliptical cross-section appearance. This fairing was added not only for appearance but on the assumption that it was aerodynamically more efficient. But as the craft developed into a warplane, the problem of weight became even more important than before, and the 275-odd pounds, not to mention extra material and production time, caused the fairing to be discarded. Aerodynamically, the "exposed" cross-section is just as efficient as that with the fairing, and many who have worked

Design Weights*

WING GROUP	
Center section	2,389.2
Wing splice	420.2
Outer panel	2,125.4
Tips	46.2
Ailerons	221.6
Flaps	388.6
Provisions for equipment	516.4
Total	6,108.0
TAIL GROUP	
Stabilizer	278.3
Elevator	267.1
Fin	199.4
Rudder	228.5
Provisions for equipment	8.6
Total	982.0
FUSELAGE GROUP	4,833.0
LANDING GEAR	
Main	2,462.2
Tail	442.7
Total	2,905.0
ENGINE NACELLE GROUP	
Nacelles	1,493.7
Provisions for equipment	44.9
Total	1,539.0
POWER PLANT GROUP	
Engine (as installed)	4,560.3
Engine accessories	437.3
Power plant controls	69.5
Propellers	1,287.4
Starting system	104.2
Total	7,677.0
LUBRICATING SYSTEM	
Tanks and protection	48.3
Piping, etc	253.2
Total	301.5
FUEL SYSTEM	
Tanks and protection	708.1
Piping, etc	208.5
Total	916.6
FIXED EQUIPMENT GROUP	
Instruments	139.7
Surface controls	385.7
Hydraulic system	861.6
Electrical	907.9
Communicating	658.5
Furnishings	
Personnel accommodations	657.6
Emergency accommodations	205.8
Provisions for flight	258.3
Air conditioning equip	373.1
Anti-icing equipment	509.2
Auxiliary power plant	124.6
Winterization	332.2
Total	5,414.0
SERVICE PICKUP	25.0
STANDARD WEIGHT EMPTY	29,483.0

* These are military version weights which, naturally, vary from those of peace-time operating models.

Performances At 45,000 lb. Gross Weight

High speed, 13,000 ft	265 mph.
Cruising speed, 10,000	227 mph.
Climb to 10,000 ft	8.5 min.
Service ceiling	29,500 ft.
Service ceiling, one engine	12,000 ft.
Takeoff run to clear 50 ft.	under 3,250 ft.

Balance Factors

Desired design gross weight CG location, 26-27% m.a.c.

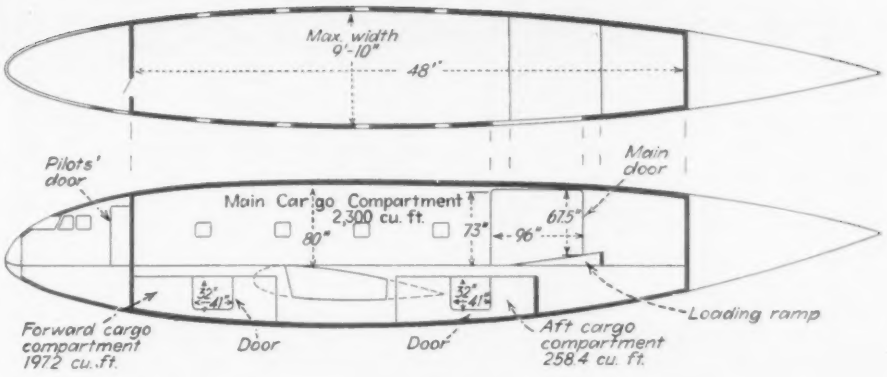
Extreme forward position CG permissible in flight, wheels down Aft l.e., m.a.c	20% m.a.c
Extreme rearward position CG permissible in flight, wheels up Aft., l.e., m.a.c	30% m.a.c.

on both the prototype and the current production model maintain today's plane is better looking.

Three Cargo Compartments

Some 2,300 cu.ft. of space are available in the cargo compartment, which is 48 ft. long and has maximum width and height of 9 ft. 10 in. and 6 ft. 8 in., respectively. In addition to general cargo, main cargo compartment arrangements of the C-46 include provisions for 40 troops, using benches which fold up against the fuselage wall; a maximum of 33 hospital litters; or five Wright GR-3350-B5 engines or their weight equivalent. Fittings are also provided on the fuselage bottom to accommodate propeller transportation support hub adapters so propellers can be attached as complete units outside the main compartment.

As a general cargo carrier, standard



floor design permits a concentrated load on any one transverse beam of approximately 435 lb. For uniform loadings, wall to wall, the standard floor will accommodate approximately 70 lb. per sq.ft., and for uniform loading over the middle half of the floor, 100 lb. per sq.ft. can be safely loaded.

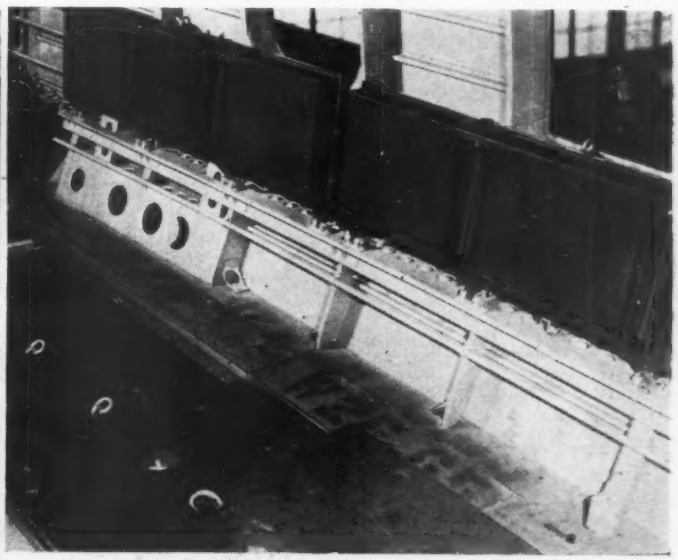
Cargo tie-down fittings are set at the juncture of the fuselage wall and floor about 21 in. apart for the full length on both sides. Similar fittings are set in the walls 31 in. above the floor line directly above those at the floor line, and a third group is set in the roof, 25 in. on either side of the center line.

None of the fittings project into the cabin, thus danger is eliminated of chaffing or puncturing fragile packages set close to the wall. All three sets of fittings are designed to take $\frac{3}{4}$ in. rope or $1\frac{3}{4}$ in. webbing straps, and any fit-

Useful Loads

	Cargo	Troop Transp.	Hospital	Task Force	Long Range
Crew	600	600	600	600	600
Fuel (in addition to normal 1,400 gal.)					
488 gal	2,928	2,928	2,928	2,928	2,928
570 gal	.....	.....	.....	.....	3,420
342 gal	.....	.....	.....	.....	2,052
800 gal	.....	.....	.....	.....	4,800
Oil	725	725	725	725	1,025
Cargo	10,078	.....	2,208	.....	.....
Troops	.....	10,000	.....	.....	.....
Patients (33)	.....	.....	5,940	.....	.....
Attendants (2)	.....	.....	400	.....	.....
Task force equip	.....	.....	.....	11,140	.....
Total useful load	14,331	14,253	12,801	15,393	14,825
Weight empty	30,669	30,848	32,199	32,256	34,849
Gross weight	45,000	45,101	45,000	47,649	49,674

Looking aft in main cargo compartment, which provides approximately 2,300 cu. ft. of cargo space. Floor adjacent to cargo door is level to expedite loading and unloading when craft is in three-point position. Main portion of floor is but 9.5 deg. from horizontal when craft is on ground; loading is further facilitated by hydraulically-operated loading winch set at fore end of compartment. Note four tracks, designed to handle aircraft engines in wheeled dollies.



Four sets of cargo tie-down fittings are available in *Commando*, three of which are shown here. At lower left are special engine eye-bolts, which may also be used for general cargo. Second set is at juncture of floor and fuselage side, with third set in fuselage bulkheads just above folded troop seats. In addition, two more rows are set in roof, 25 in. on either side of center line. All tie-down brackets are designed to use $\frac{3}{4}$ in. rope or $1\frac{3}{4}$ in. webbing straps.

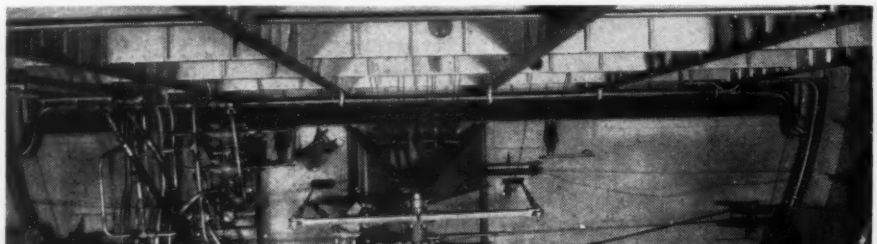
ring will take at least 200 lb. tension in any direction within the fuselage.

Protection from damage by cargo to fuselage bulkheads and skin is given by rows of metal tubes running the full length of the compartment up to a height of 31 in. above the floor.

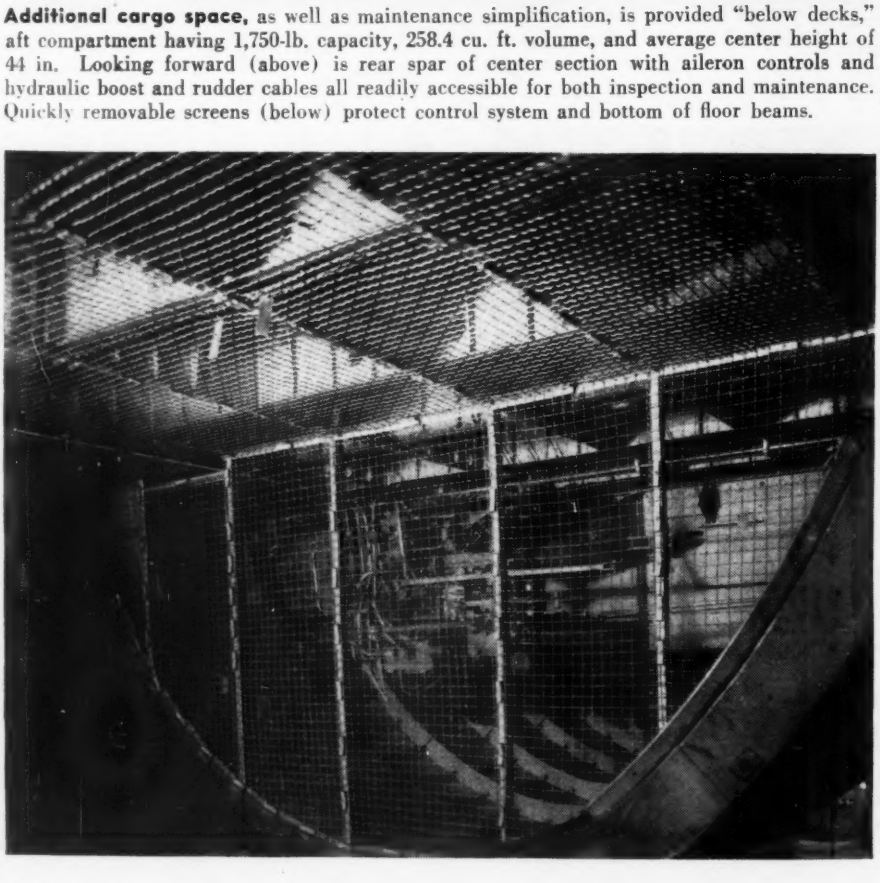
For engine loading, two pairs of tracks are set in the floor and are so constructed that the concentrated loads are well distributed. Two rows of tie-down fittings are set in the floor, 25½ in. on each side of the center line. The tie-down rings, of 1½ in. inside diameter, are provided with eye bolts to be screwed into the fittings for general cargo or task force equipment.

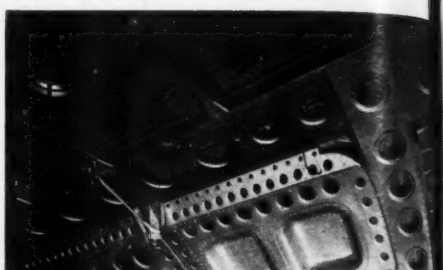
As an ambulance plane—a role in which the *Commando* is doing yeoman service en route home from war theaters—hospital litters are arranged in two rows, one on each side of the compartment, on special stanchions running from the floor to the roof. If the litters are set up parallel to the floor, 33 can be accommodated. They can, however, be sloped up to 13 deg. fore or aft for special cases, when 24 may be accommodated.

Development of the plane from a peacetime passenger transport to a task force craft brought redesign even to the main cargo loading door through increasing its size to a 96-in. width and with depth at the fore edge of 78.5 in. and 66.5 in. aft. Reason for the greater height at the fore edge is that the floor just inside the door is installed so that it is level when the plane is in three point position. This level portion, created to facilitate loading, extends 18 in. ahead of and behind the door to further simplify cargo handling. The cargo door is divided vertically in two sections both of which open up and out. The forward section has an auxiliary



Additional cargo space, as well as maintenance simplification, is provided "below decks," aft compartment having 1,750-lb. capacity, 258.4 cu. ft. volume, and average center height of 44 in. Looking forward (above) is rear spar of center section with aileron controls and hydraulic boost and rudder cables all readily accessible for both inspection and maintenance. Quickly removable screens (below) protect control system and bottom of floor beams.





Light weight is combined with strength in construction of 96-in. wide main cargo door, which swings out and up for loading. Door is divided vertically so that two segments can be opened independently. Forward segment contains auxiliary passenger door, measuring 30 in. in width by 55 in. in height, hinged at its leading edge.

Fuselage Dimensions

Main cargo compartment	
Length	48 ft.
Maximum height	6 ft. 8 in.
Maximum width	9 ft. 10 in.
Cu. ft. content	2,300 ft.
Loading door, height	66.5–78.5 in.
width	96 in.
Fore lower compartment	
Cu. ft. content	197.2 ft.
Length	148 in.
Ave. center height	44 in.
Weight capacity	3,450 lb.
Loading door, height	2 ft. 8 in.
width	3 ft. 5 in.
Aft lower compartment	
Cu. ft. content	258.4 ft.
Length	143 in.
Ave. center height	44 in.
Weight capacity	1,750 lb.
Loading door, height	2 ft. 8 in.
width	3 ft. 5 in.

door, opening in and up and measuring 55 in. high and 30 in. wide.

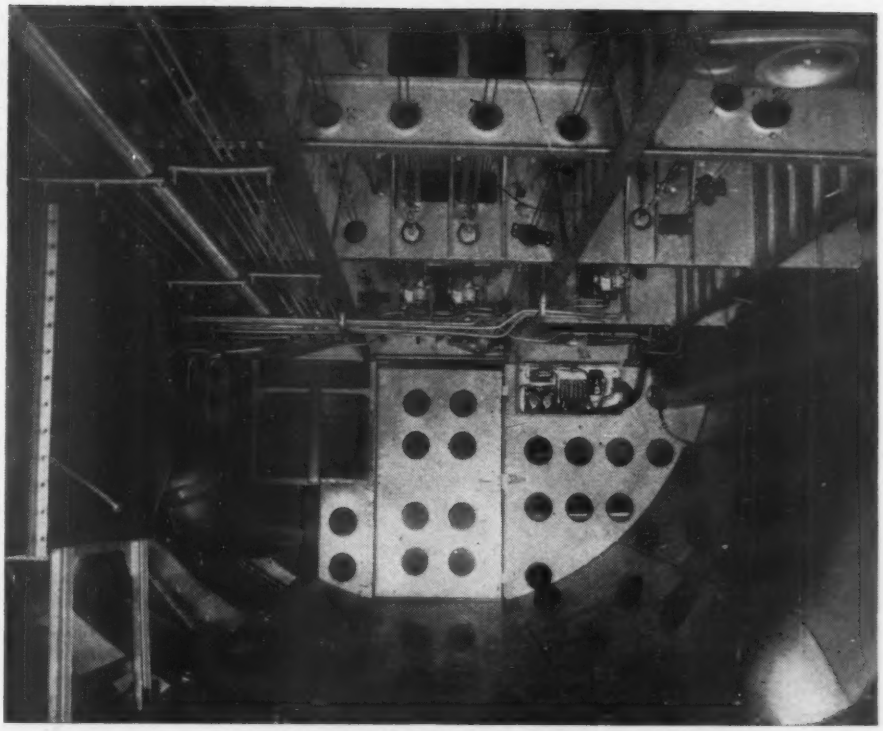
Three extra 20.5 x 26 in. auxiliary exits are provided, one on each side of the main cargo compartment just above the wing and one on the right side opposite the main cargo door. They are released inward by pulling two handles.

Additional cargo space (as well as unusual maintenance features to be discussed in detail later) is provided in two compartments fore and aft of the wing center section below the floor line. With a length of 148 in. and average center headroom of 44 in., the fore lower compartment has a volume of 197.2 cu.ft. and capacity of 3,450 lb., and the aft compartment, measuring 143 in. in length and of the same average headroom, has a volume of 258.4 cu.ft. and capacity of 1,750 lb. Both compartments are accessible from the ground through doors of 3 ft. 5 in. width and 2 ft. 8 in. height, both on the right side of the fuselage. Adequate compartment lighting is provided by built-in protected lights operating from the plane's electric system. The fore lower compartment is accessible in flight through a trap door in the floor just behind the pilot's seat.

Pilots' Cabin Design

Providing space for two pilots and radio operator, the pilots' cabin fellows the basic design, which included visibility and comfort as prime considerations. Both pilots' seats, for example, have fore and aft travel of 9¼ in. and can be raised or lowered 5¼ in. The windshield follows the contour of the fuselage, its outer surface being flush with the skin. Downward vision is enhanced by extra side panels, the lower edges of which are about level with the pilot's seat.

A door connects the pilots' cabin with the main compartment, and an emergency exit 20 in. wide and 50 in. high is set in the left wall. All engine controls are grouped on the pedestal between the pilots. The 25-odd flight, engine and avigation instruments—all "black lighted"—are grouped in four panels, two on each side of the automatic pilot. For ease and speed of maintenance, each panel may be removed individually, or the panel as a whole can be taken out. Instrument maintenance from the back of the panel is also facilitated by the fact that the nose section of the fuselage can be

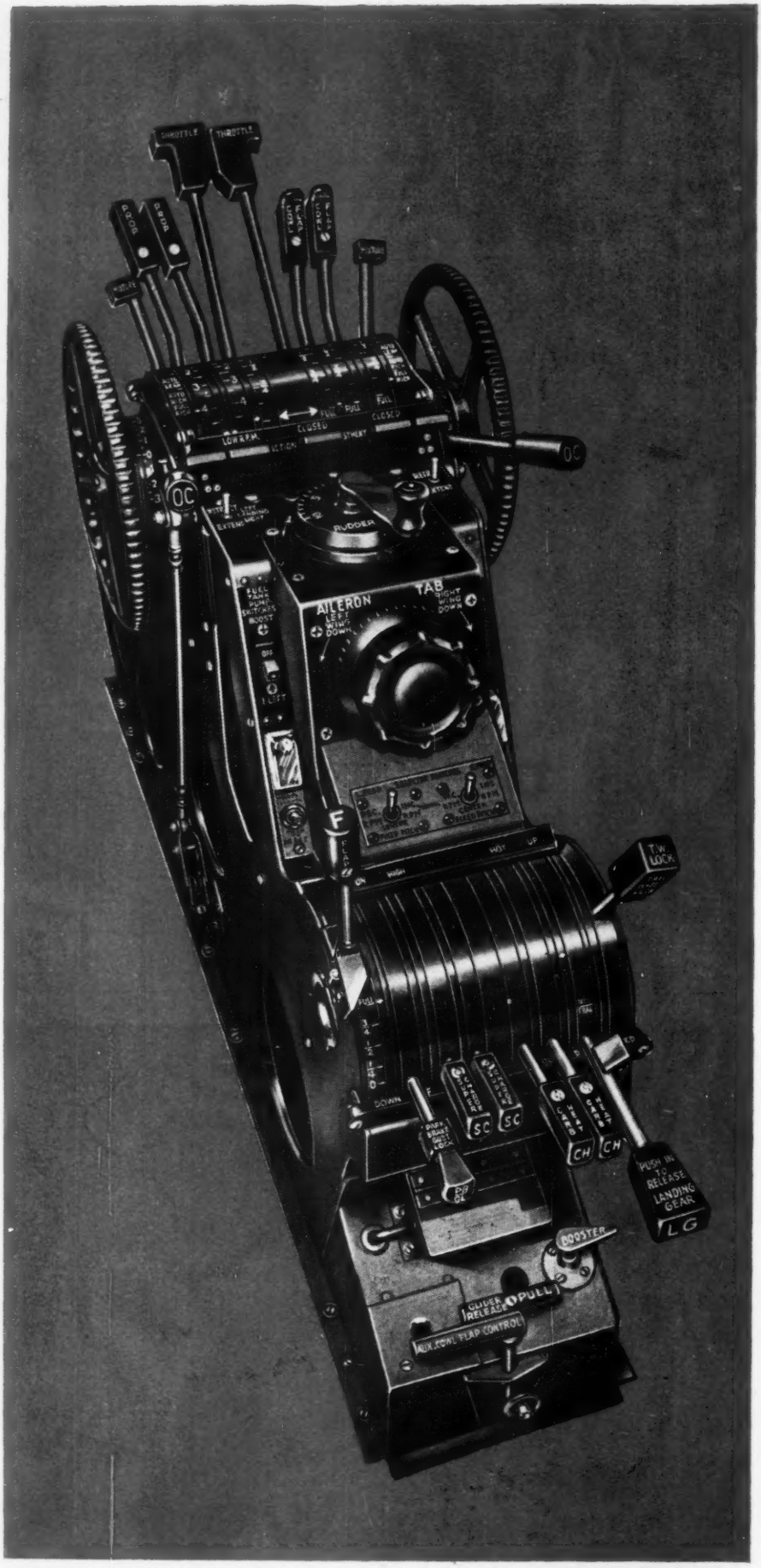


Fore lower cargo compartment, which is accessible in flight via trap door in floor just behind pilot's seat, has capacity of 3,450 lb., volume of 197.2 cu. ft., and average center headroom of 44 in. As in aft compartment, control cables and plumbing are easily accessible for maintenance. Both compartments are reached from ground through 3 ft. 5 in. wide and 2 ft. 8 in. high doors.

Standard Instrument Equipment

Altimeters (2)	Manifold pressure gage	Fuel flowmeter gage
Turn indicator	Tachometer	Cyl. head temp. gage
Flight indicator	Carburetor temp. gage	Mixture indicator
Airspeed indicators (2)	Free air temp. gage	Main hydraulic pressure gage
Turn and bank indicator	Oil temp. gage	Auto. pilot pressure gage
Climb indicator	Oil pressure gage	Flap position indicator
Radio compass	Fuel pressure gage	De-icer pressure gage
Magnetic compass	Fuel level gages (3)	Clock
	Vacuum gage	

Pilot's cabin of C-46 was designed with visibility and crew comfort as prime considerations. Pilot seats, fitting into pedestals at lower left and right, can be moved 9¼ in. fore and aft and raised or lowered 5¼ in. Extra window panels, coming down to about level of seats, increase downward visibility.



"Commando's" control quadrant has been designed to make all engine and gear controls fully accessible to either pilot or co-pilot. Note how each is provided elevator trim tab control, with rudder and aileron tab controls in center of quadrant and well toward top.

easily removed, giving plenty of working space on the plumbing and wiring.

Wing design was guided principally by a policy determined to produce a foil with the necessary speed qualifications, yet free of tip stall. Altogether, nine wings with different foils and twist in were wind-tunnel-tested at Massachusetts Institute of Technology and California Institute of Technology. The foil selected—NACA-23017 at the root and NACA-4410.5 at the tip—is standard on production models as well as the prototype. No compromise between foil and structure was found necessary; for the engineers made it a point to design the landing gear so that it does not go into the wing structure since, in retracted position, the wheel is between the engine and the front spar.

Wings Follows Basic Design

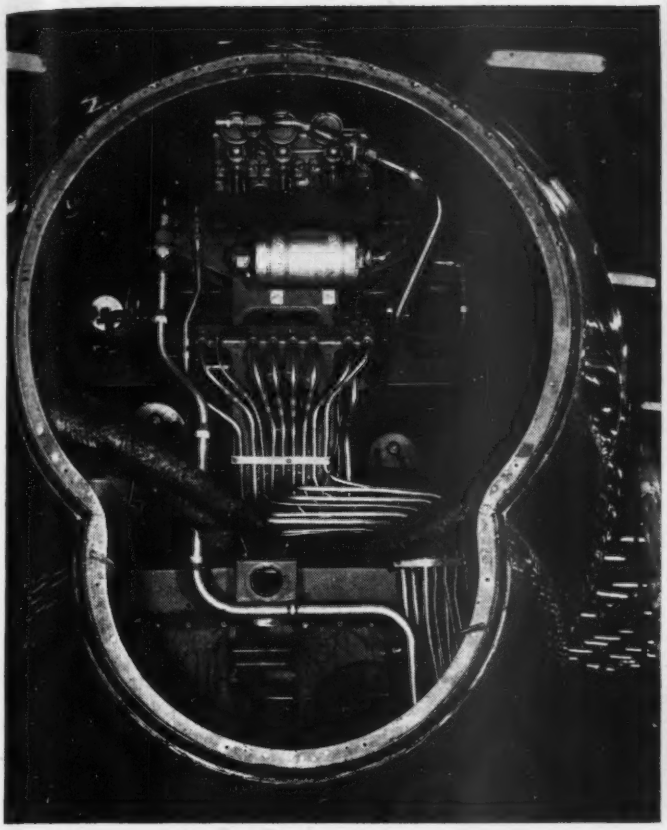
Of full cantilever construction, the wing is built in three sections—an untapered center section and two outer panels with detachable tips. The center section is continuous through the fuselage, with three built-up spars taking landing and flying weights. The fore spar, running only through the center section, was provided to get the maximum moment of inertia and to provide a torque box within a limited area. The landing gear fittings and engine nacelles attach to this spar.

All three spars are stiffened shear webs, with extruded flanges next to the skin. Center section ribs are truss type, built up of rolled and extruded sections. Stressed skin of 24ST Alclad is used throughout the wing, with an interesting design for additional rigidity provided by span-wise hat shaped stiffeners of rolled 24ST Alclad sheet stock riveted by the base to the inside of the skin and, in turn, riveted to the ribs by special channel shaped connections fitting over the "crown" of the stiffener. Although in production it has proved as simple to handle as conventional stringers, this construction gives the added strength of a corrugated structure which flight tests and field service have proven minimizes changes in airfoil through wrinkling.

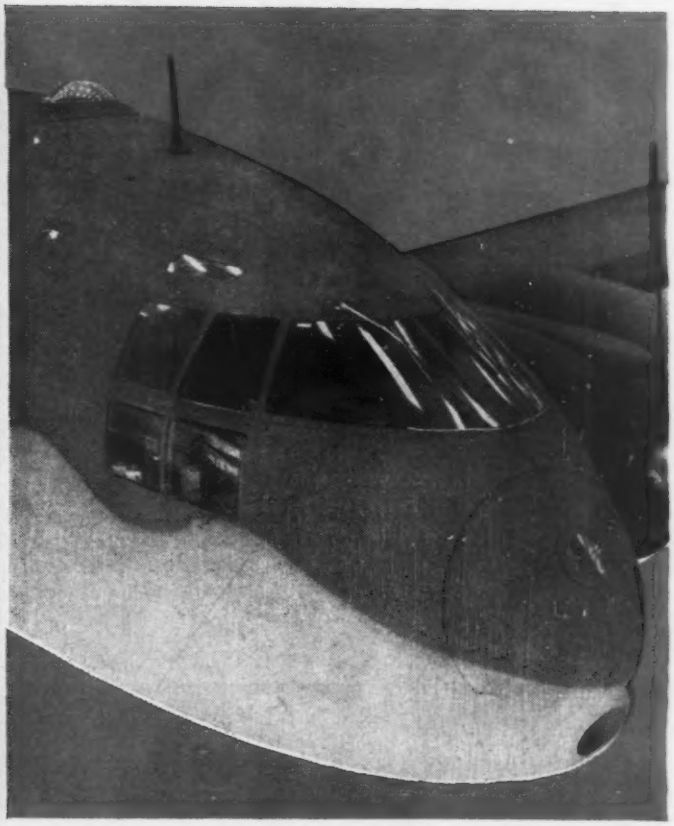
Nacelles Interchangeable

Built as separate assemblies which may be changed in service if necessary, the engine nacelles are riveted to the center panel. The nacelles, of aluminum alloy, are of semi-monocoque construction with transverse rings and stringers, and five longerons, four of which carry fittings to attach the engines and firewalls. The firewalls are of "sandwich" type—light gage stainless steel forward, asbestos sheet for "filling," and aluminum alloy aft. Engine mounts are conventional design chrome molybdenum

(*Turn to page* 140)

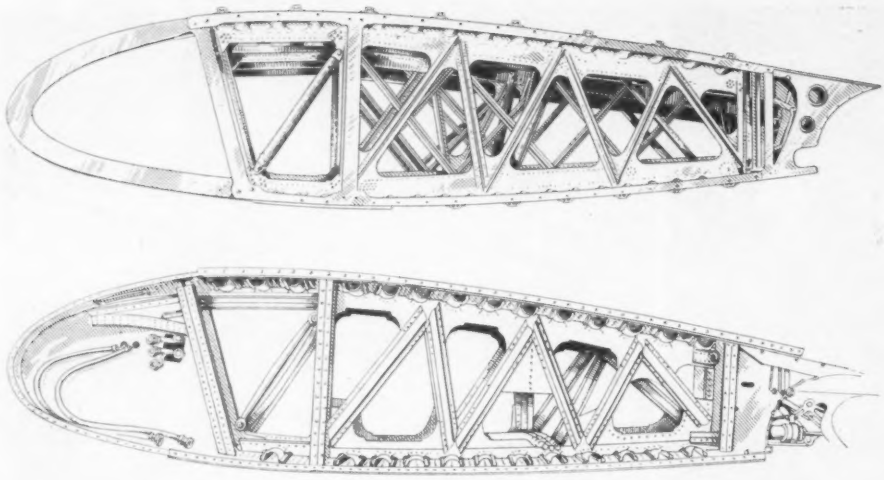


Readily removable tip of fuselage nose facilitates inspection and service of plumbing and wiring in back of instrument panel. As a further aid to maintenance, the 25-odd engine, flight, and navigation instruments are grouped in four panels, any of which may be removed individually or as complete unit.



Windshield follows contour of fuselage to increase performance and is provided with both anti-icer unit and mechanical wiper. Flush riveting is employed on all "drag sensitive" areas (approximately forward third) of fuselage, wings, and empennage groups. Removable nose tip for instrument maintenance is clearly outlined.

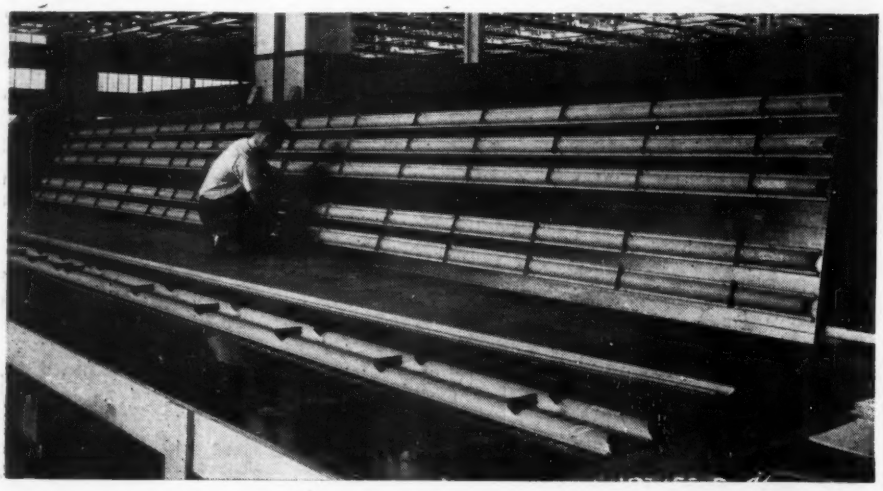
Full cantilever wing is built in three sections—untapered center section and two outer panels with detachable tips. Center section (above) runs through fuselage just below cabin floor. Three spars are utilized in this section, with engine nacelles and landing gear fittings attaching to fore spar. Note aileron control hinge fitting at lower center, flanked by inboard flap hinges.



Development of truss type center section ribs from prototype CW-20 to current production model C-46 is shown here in detail sketches, revealing C-46 ribs (bottom) as being comprised largely of rolled sections and extrusions to give maximum strength and minimum weight. Engine nacelle-landing gear compression member, seen between fore and main spars, has also been changed from angular to round shape.

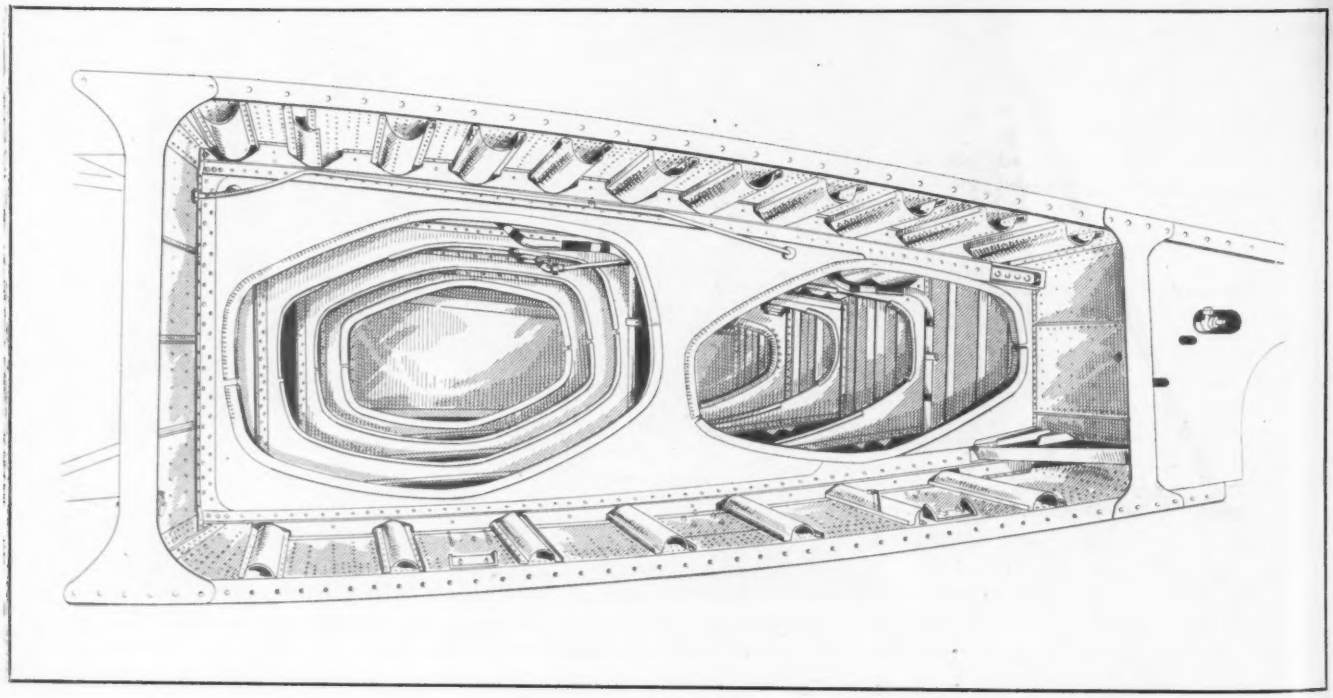
Wing Data

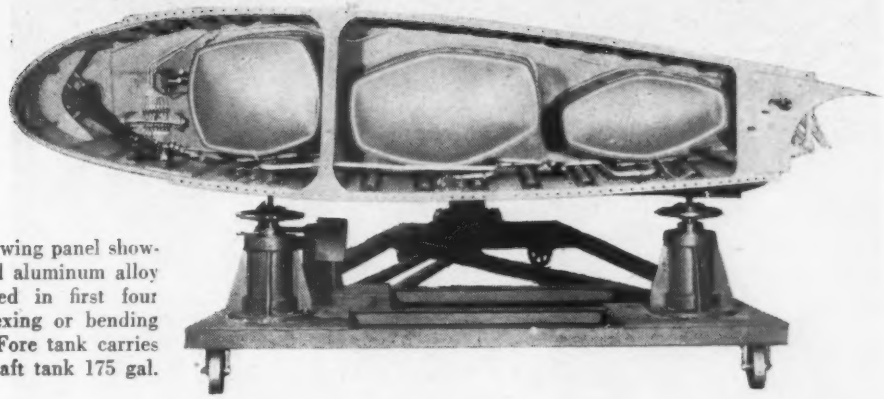
Airfoil section, root	NACA 23017
tip	NACA 4410.5
Area, including ailerons and flaps	1,360 sq. ft.
Aspect ratio	8.58
Chord, center panel	198 in.
Chord, outer panel root	198 in.
Chord, tip	70.81 in.
Mean aerodynamic chord length	164.25 in.
Sweepback, leading edge	11.4 deg. (92 in.)
Taper ratio	2.7:1
Incidence, root	3.5 deg.
Incidence, tip	0.5 deg.
Dihedral, 70 percent chord	7 deg.
Maximum rib spacing	30 in.
Shear webs or spar locations	30 & 70%
Wing loading (45,000 lb. gross)	33.09 lb. sq. ft.
Power loading (45,000 lb. gross)	14.06 lb. sq. ft.
Load factor, ultimate (45,000 lb. gross)	4.96



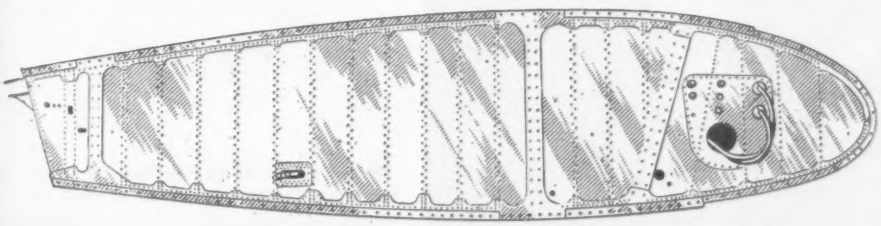
Wing skin (left) is 24ST Alclad, with interesting construction-for-rigidity in form of spanwise hat shaped stiffeners riveted to inside. This design has been found as simple in production as conventional stringers but, with no appreciable weight increase, gives added strength of corrugated structure.

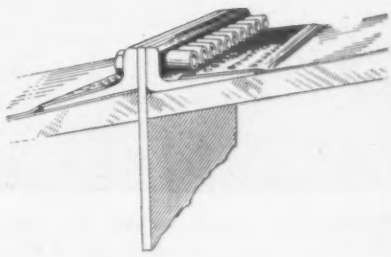
Cross section of wing between spars gives details of corrugated effect created by spanwise hat shaped stiffeners used in place of conventional stringers. Flight tests and field service have shown this design to be very efficient in eliminating airfoil changes due to wrinkling.





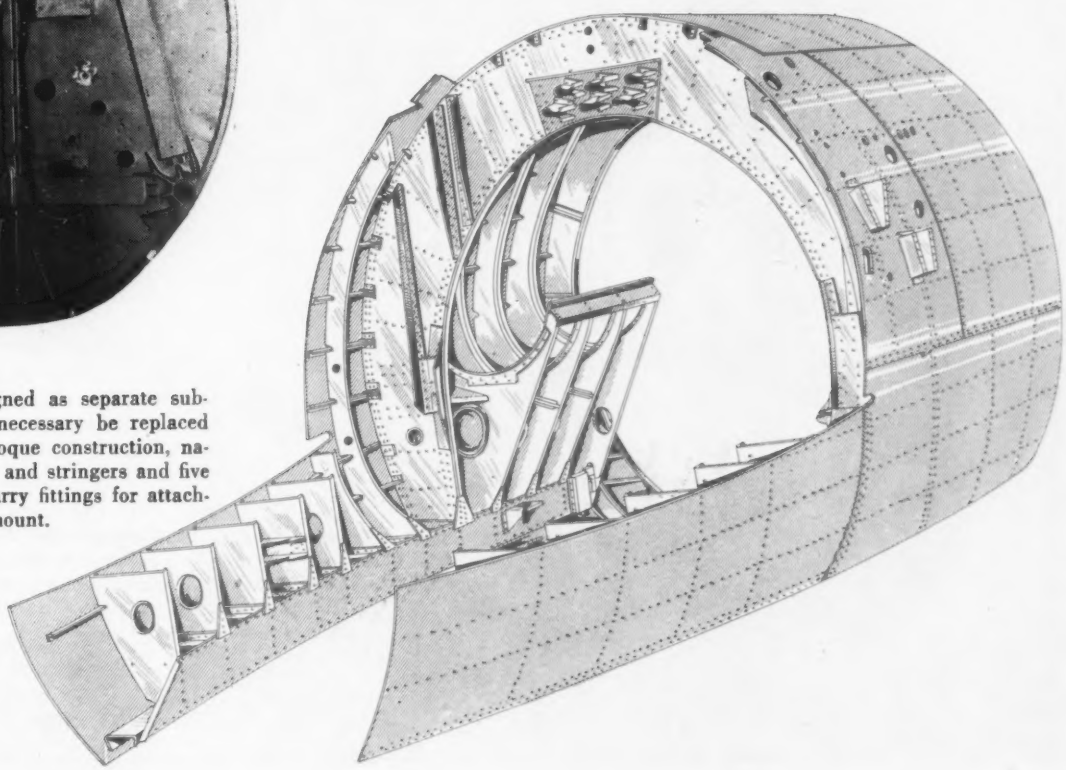
Profile of inboard end of outer wing panel showing installation of three standard aluminum alloy fuel tanks, which are supported in first four cutout ribs so arranged that flexing or bending cannot be transmitted to tanks. Fore tank carries 242 gal; mid-tank 283 gal; and aft tank 175 gal.



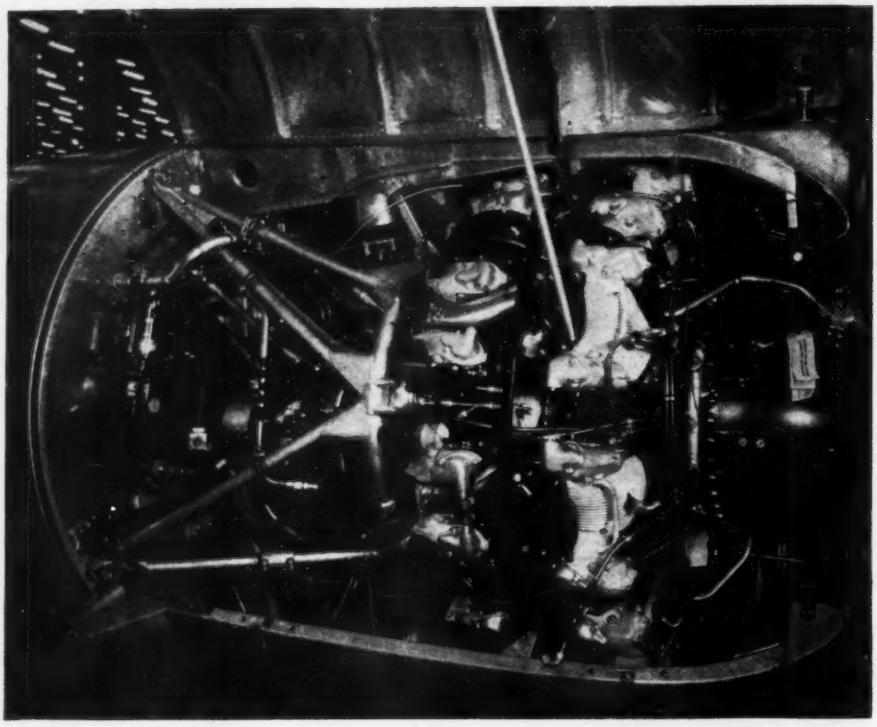


Outer wing panels attach to center section through this splice plate by special high strength bolts encircling wing from leading edge to aft of rear spar. Detail sketch at right shows cross sectional view of method used in attaching panels through splice plate.

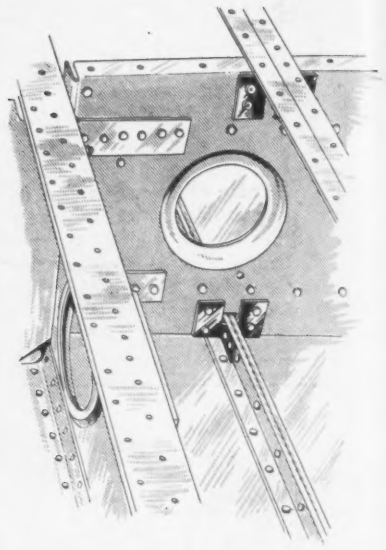
Sandwich type firewalls (left) are comprised of light gage stainless steel nearest engine, backed by asbestos sheet "filling" and aluminum alloy sheet aft.



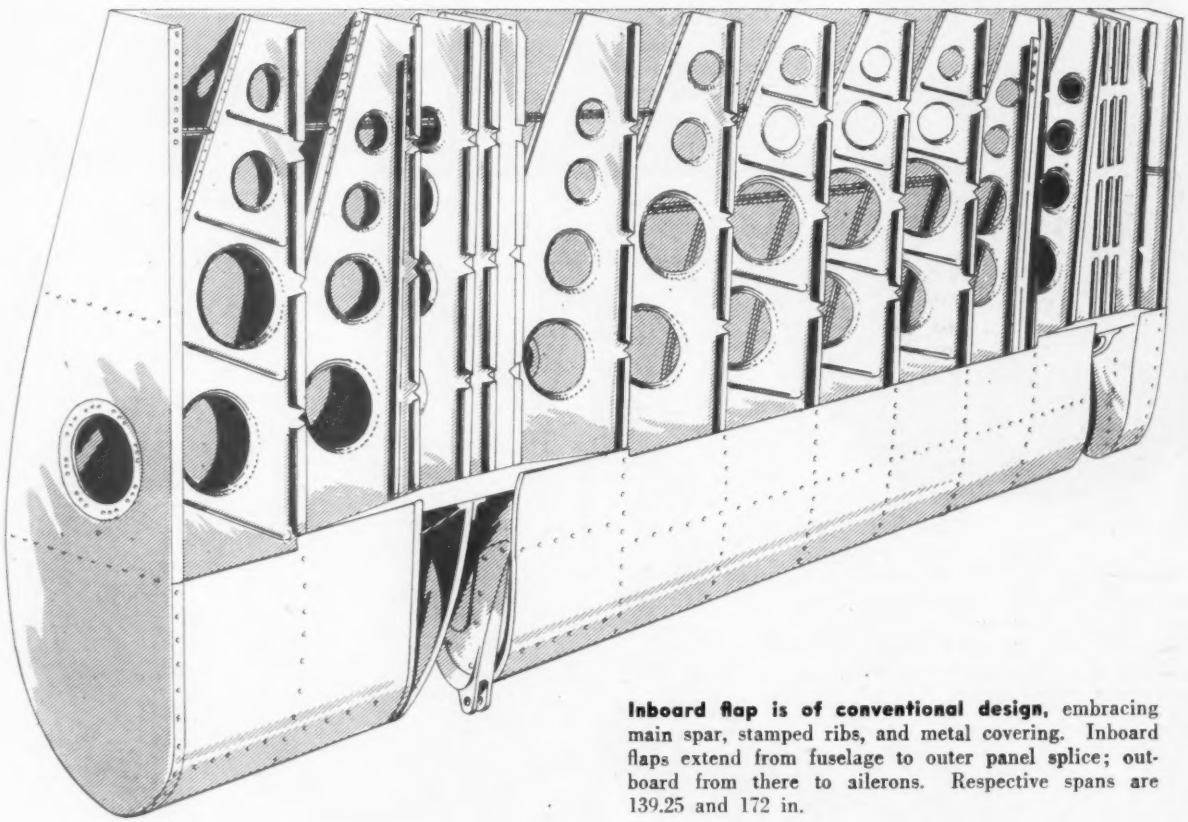
Engine nacelles are designed as separate subassemblies which may, if necessary be replaced in service. Of semi-monocoque construction, nacelles have transverse rings and stringers and five longerons, four of which carry fittings for attaching firewalls and engine mount.



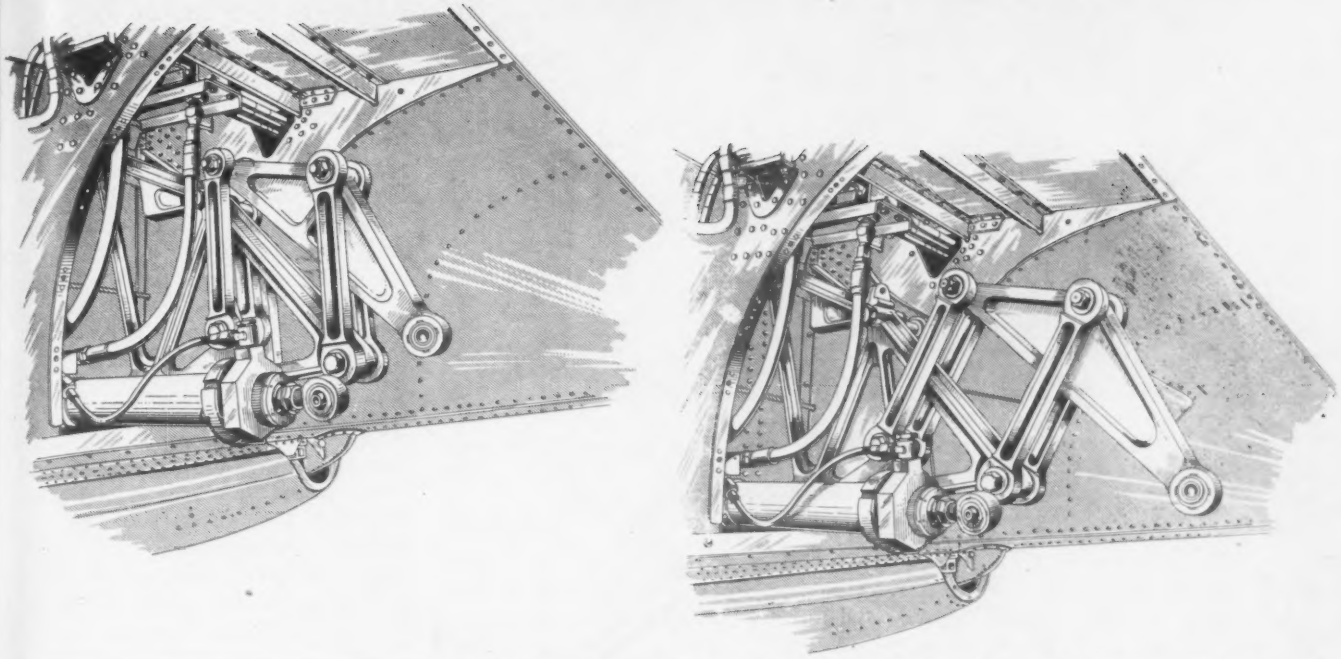
"Commando" engine mounts are conventional-design chrome molybdenum steel tubing, with fittings welded to mount ring at six points for attachment.



Detail illustrating method of using small clamps, which are riveted to flap ribs and stringers, to prevent skin from pulling loose under hard service. Such clamps are used in empennage units as well as in both inboard and outboard flaps.



Inboard flap is of conventional design, embracing main spar, stamped ribs, and metal covering. Inboard flaps extend from fuselage to outer panel splice; outboard from there to ailerons. Respective spans are 139.25 and 172 in.



First stage of operation of Curtiss-designed hydraulic flaps is direct rearward movement of 3 in. to create slot. Then, via pantograph action mechanism shown here, flaps pivot downward to maximum of 35 deg. for landing, or any intermediate position for takeoff. Sketch at left shows flap actuating mechanism in retracted, or "up" position; that at right in extended or "down" position. Photograph below gives detail of outboard flap mechanism (top) and inboard mechanism with flaps in down position.

Flap Data

Span, inner flaps, each	11 ft. 2 in.
Area, inner flaps, each	46.92 sq. ft.
Span, outer flaps, each	14 ft. 3 in.
Area, outer flaps, each	51.79 sq. ft.
Total span, each side	25 ft. 5 in.
Chord, center and outer panels	4 ft. 1¼ in.

Flap effectiveness C_l increased from 1.55 to 2.21, an increase of 42.6%

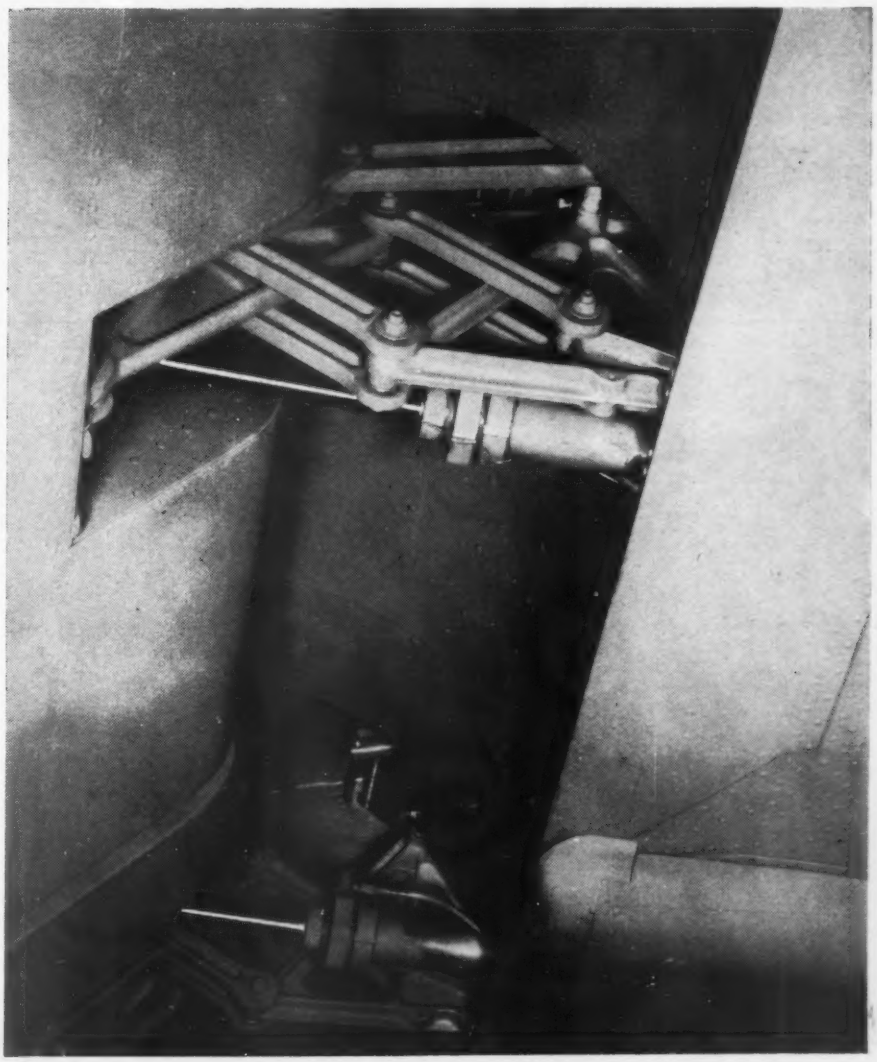
steel tubing. Fittings are welded to each engine mount ring at six points for attachment, and cushion-type engine support fittings are furnished with the engine. All welded subassemblies parts are normalized.

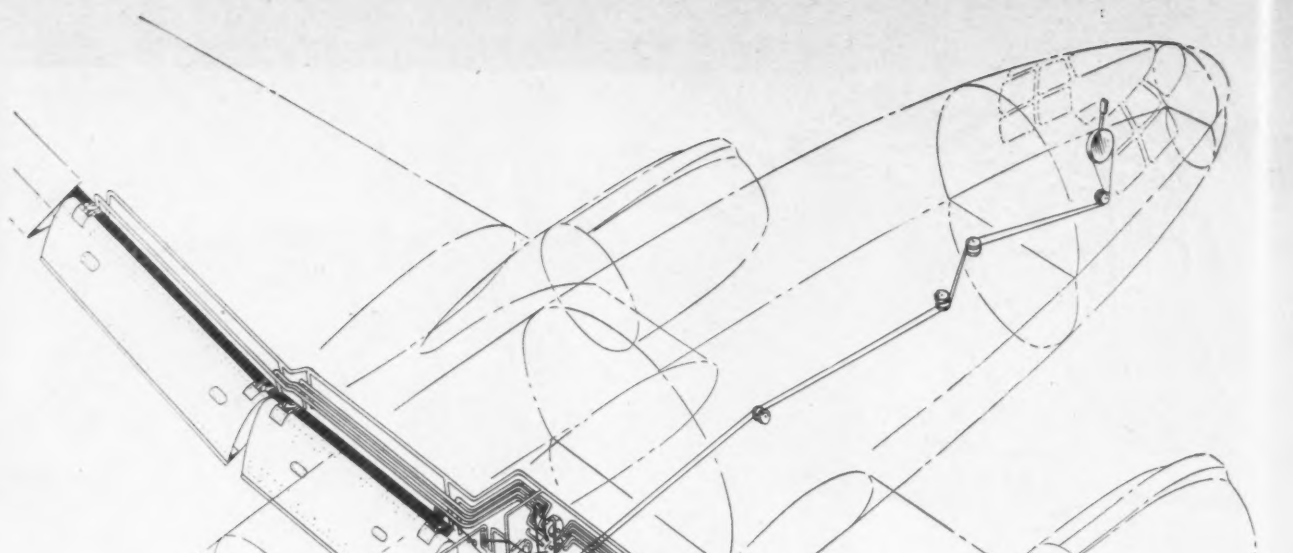
To facilitate maintenance, this portion of the C-46 has been designed so that the entire power plant, engine mount, firewall, and all accessories forward of the firewall, can be removed as a unit, with complete interchangeability between units and between right and left on the same plane.

Designed for Maintenance

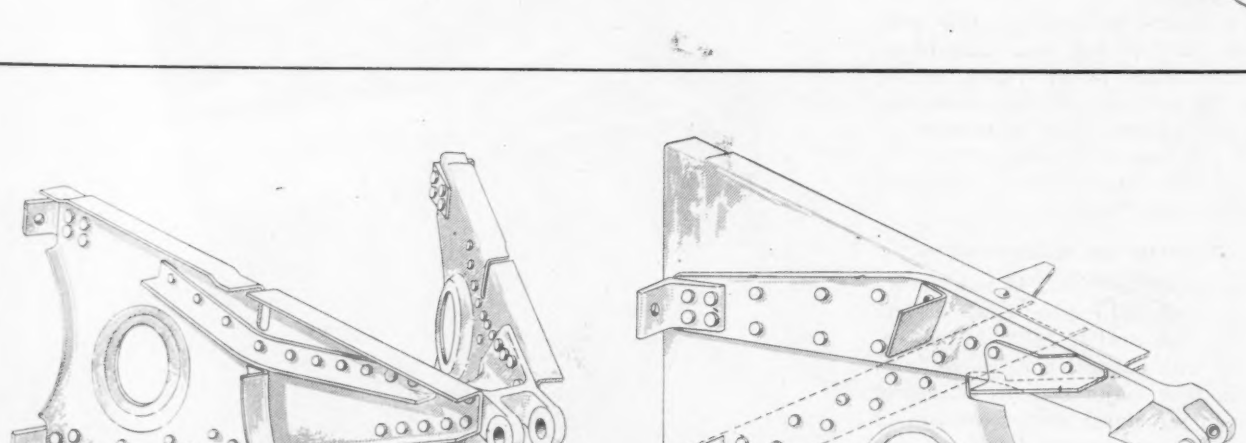
Field service has brought refinements to the unusual engine cowl design. Basically, the cowl is 24ST Alclad, reinforced with channel and hat sections, built in four major sections consisting of a top structural section containing the carburetor air scoop, two large side segments, and a bottom section containing the oil cooler scoop. Instead of having venturi type flaps completely encircling the engine, the top and two side segments are flush with the nacelle, giving a much smoother airflow over the top of the wing and reducing drag to a considerable degree.

In the original conception, the side sections of the cowl were designed to be opened by removing fasteners along the bottom edge of each segment, which then swung out and up on a continuous





Flap hydraulic system includes eight struts (two for each flap), control valve, single flow equalizer, two dual flow equalizers, relief valve and essential lines, and check valves and fittings, with mechanical control from one flap lever on control quadrant.



Aileron hinge ribs, showing construction types used on **two of six for each aileron.**

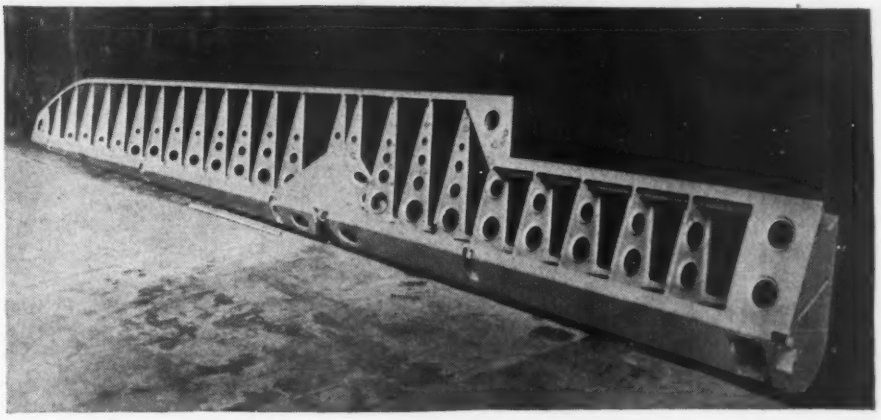
hinge at the top along the carburetor air intake, with the lower section being detached by removing similar fasteners. These are being redesigned, however, so that the top segment hinges at the back, giving quick, complete access to all cylinders within that periphery, while the bottom segment is being broken into smaller subassemblies so that a quickly removable forward-swinging panel gives access to cylinder heads in the lower third area.

The cowling flaps, too, have been modified, resulting not only in excellent cooling control but also increased aerodynamic efficiency. Perhaps no better evidence of this cooling control can be given than the fact that a C-46, with a gross load of 40,000 lb., has successfully towed two loaded CG-4 gliders to 10,000 ft. in a shade over 29 min. and without overheating. These new flaps are of the expanding fan type, covering the lower 120 deg. of the cowling.

Outer Wing Panels

In addition to retaining the hydraulic flap operation, the new cowling retains another prototype feature: The cowling is attached to the engine mount and to the nacelle via a cantilever structure and is not fastened to the engine proper. This greatly reduces vibration which, in turn, means a lighter weight cowl designed to give better field service.

Removable outer wing panels are attached to the center section just outboard of the engine nacelles by special high-strength bolts encircling the wing through a splice plate. The first four ribs of the outer panel are web type, with large irregular hexagonal cutouts to allow space for three fuel tanks. The fifth rib is solid aluminum alloy with extruded flanges, and from there on out to the tips, ribs are web-truss type. These ribs are formed in one hydropress operation, the cutouts being blanked and a bead for added stiffness being put in during the one press stroke. Detachable wingtips are attached by machine screws.



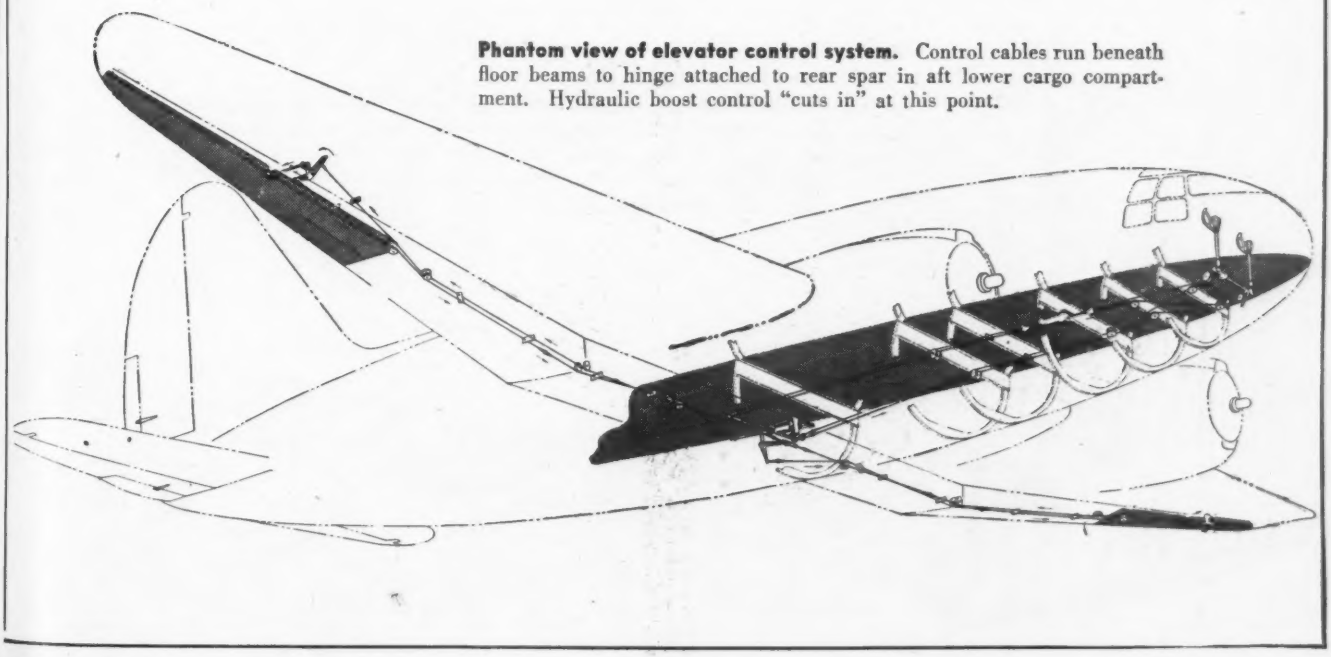
Only fabric covered surfaces on *Commando* are ailerons, which have metal spar and 24ST stamped ribs. Static and dynamic balance is obtained by weight along leading edge ahead of hinge line. Attachment is by six ball bearing hinges, and ailerons swing in arc ranging from 35 deg. above horizontal to 20 deg. below.

Aileron Data

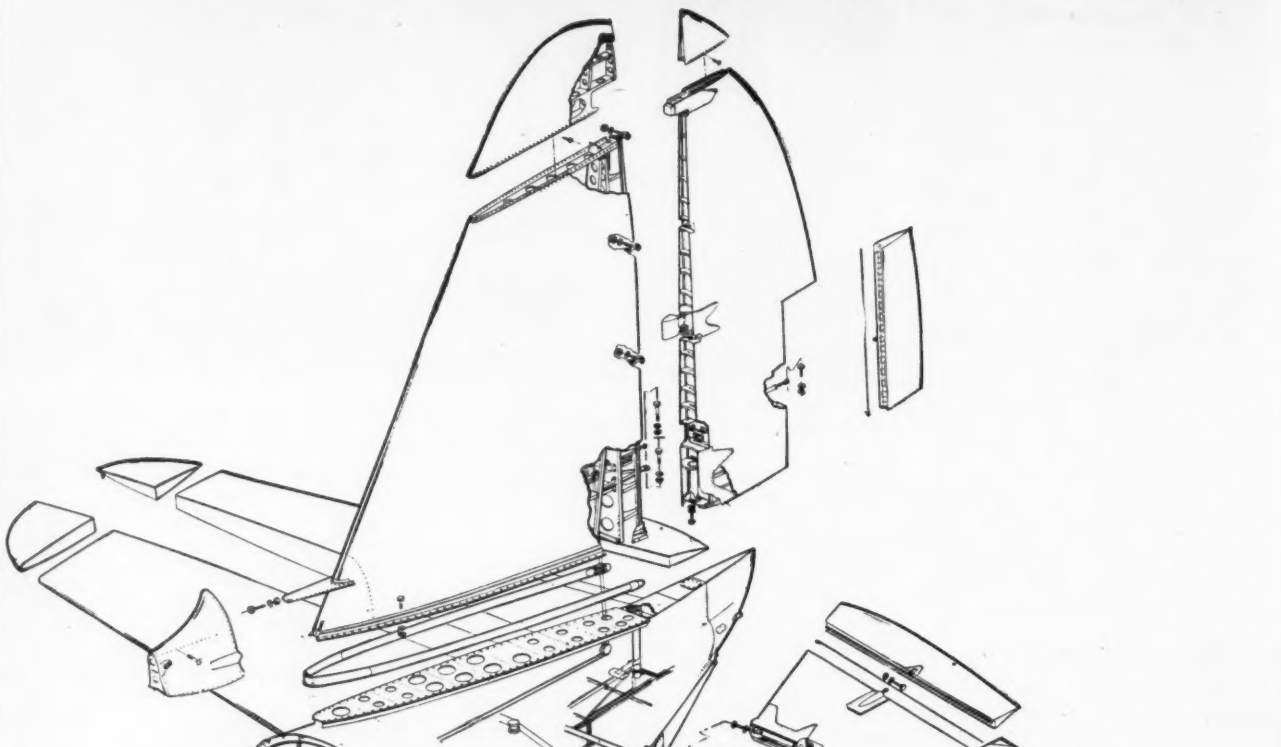
Area, aft of hinge center (inc. tabs)	30.9 sq. ft.
Area of balance	8.7 sq. ft.
Total area, each	39.6 sq. ft.
Span	254.6 in.
Chord (ave.)	27.5 in.
Arc	up 35 deg., down 20 deg.
Single spar, stamped 24ST ribs, fabric covered	
Tab area	3.97 sq. ft.
span	58.5 in.
maximum chord	10.30 in.

Vital contributions to the *Commando's* performance are given by the four Curtiss hydraulically-operated flaps which, in the first stage of operation, move 3 in. directly to the rear to create a slot and then, via a pantograph linkage, pivot downward to a maximum of 35 deg. for landing or any intermediate angle to shorten takeoff run.

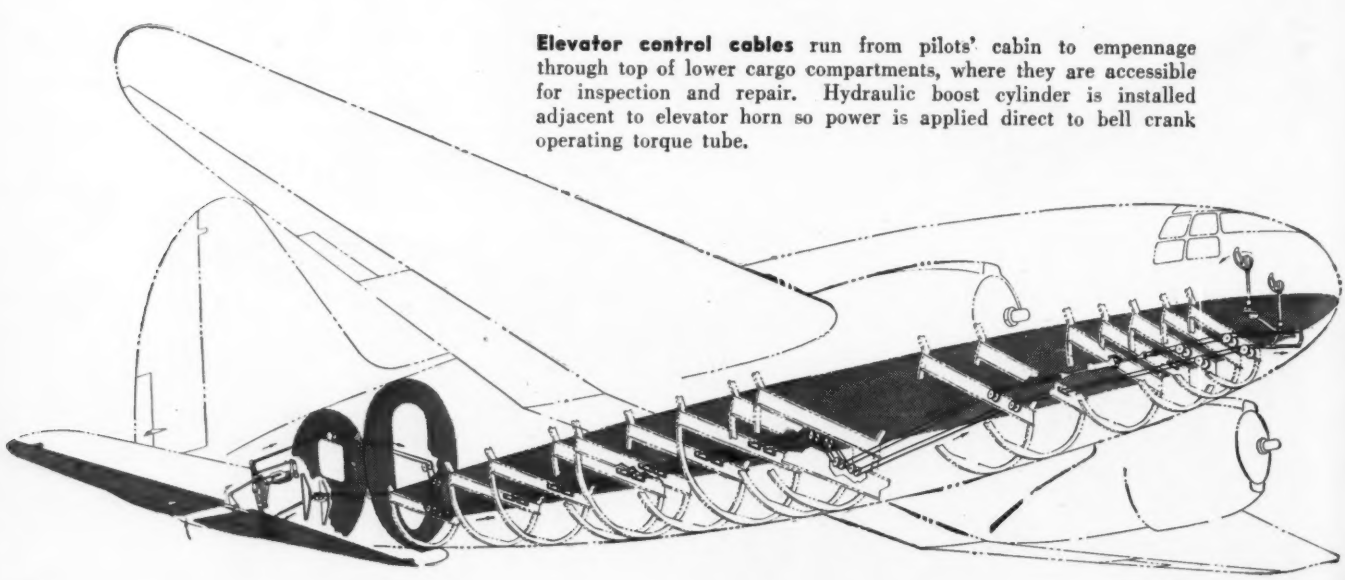
There are two pairs of flaps, the inboard extending from the fuselage to the outer panel splice and having a span of 134.63 in. and an area of 46.92 sq.ft., and the outboard flaps extending to the ailerons with a span of 171 in.



Phantom view of elevator control system. Control cables run beneath floor beams to hinge attached to rear spar in aft lower cargo compartment. Hydraulic boost control "cuts in" at this point.



Empennage group includes fuselage tail cone, containing well and fittings for fully retractable tail wheel. Both fin and stabilizers are attached to fuselage with special high strength bolts in manner similar to that used for outer wing panels. Production and maintenance are simplified by right-left interchangeability of stabilizers and elevators.



Elevator control cables run from pilots' cabin to empennage through top of lower cargo compartments, where they are accessible for inspection and repair. Hydraulic boost cylinder is installed adjacent to elevator horn so power is applied direct to bell crank operating torque tube.

and an area of 51.79 sq.ft. each. The flaps themselves are of conventional construction, having a main spar and stamped ribs, metal covered.

The ailerons are the only fabric covered surfaces on the C-46. The leading edge is a torsion box, and a single spar of flanged sheet metal with lightening holes is employed. Stamped ribs are 24ST. Each aileron—with an area of 39.57 sq.ft.—is attached by six ball bearing hinges and has an arc of 35 deg. above horizontal to 20 deg. below. Static and dynamic balance is obtained by a lead weight along the leading edge, forward of the hinge line. Each aileron has a trapezoidal shaped trim tab along the inboard trailing edge, the span being 58.5 in., maximum chord 10.30 in., and area 3.97 sq.ft.

Production and maintenance simplification are promoted by design in the empennage group, for both stabilizers and elevator panels are interchangeable right and left.

Empennage Units Interchangeable

Stabilizers are full cantilever, all metal stressed skin construction, with three beams extending outboard from the root along constant percentage lines. Additional skin support is given by intermediate bulb-angle stringers. Formed sheet-metal removable tips are attached with machine screws, and the stabilizer itself attaches to the fuselage with bolts through splice angles. Since both panels are structurally identical, the only difference in their use on right or left side would come from the rigging of the elevator tab motor installations.

Structurally identical elevator panels are all metal, with two beams, stamped ribs, and detachable tips attached with machine screws. Each panel is attached to the stabilizer by four readily removable ball bearing hinges. A steel torque tube, bolted to the inboard end near the hinge line, extends into the fuselage center line, where it attaches to the control horn, on each side of which there is a ball bearing support. Elevators swing over an arc ranging from 33 deg. above horizontal to 17 deg. below, and they have a total area of 98.7 sq.ft. Dynamic balance is in the form of a streamlined weight mounted forward of the hinge line near the tip.

Trim tabs, accounting for approximately 15 percent of the elevator area, are all metal and attach to the elevator by a continuous piano-type hinge. Adjustment is via a push-pull tube extending to the tab motor shaft in the stabilizer. Tab span is 86 in., maximum chord is 17.58 in., and area is 9.35 sq.ft.

As are the other empennage units, the 115.4 sq.ft. area fin is full cantilever and of all metal stressed skin construction with six beams extending up from the root along constant percentage lines. Additional skin support is given by intermediate bulb angle stringers. Like other units it, too, has a detachable tip attached by machine screws, and the whole unit is attached to the fuselage with bolts through splice angles with a normal setting of 0 deg.

Stabilizer Data

Total area	158.5 sq. ft.
Span (total)	36 ft. 4.4 in.
Chord (maximum)	5 ft. 4.6 in.
Setting (fixed)	+0.5 deg.
Panels interchangeable right and left.	

Elevator Data

Total area	98.7 sq. ft.
Arc	up 33 deg., down 17 deg.
Tabs, area	9.35 sq. ft.
span, each	86 in.
max chord	17.58 in.

Fin Data

Total area	115.4 sq. ft.
Height	14 ft.
Chord (root)	11 ft. 10 in.
Setting (fixed)	0 deg.

Rudder Data

Total area	52.8 sq. ft.
Arc	20 deg. right, 20 deg. left
Tab, combination trim-balance type	
Area	7.02 sq. ft.
Length	65.12 in.
Max. chord	16.65 in.

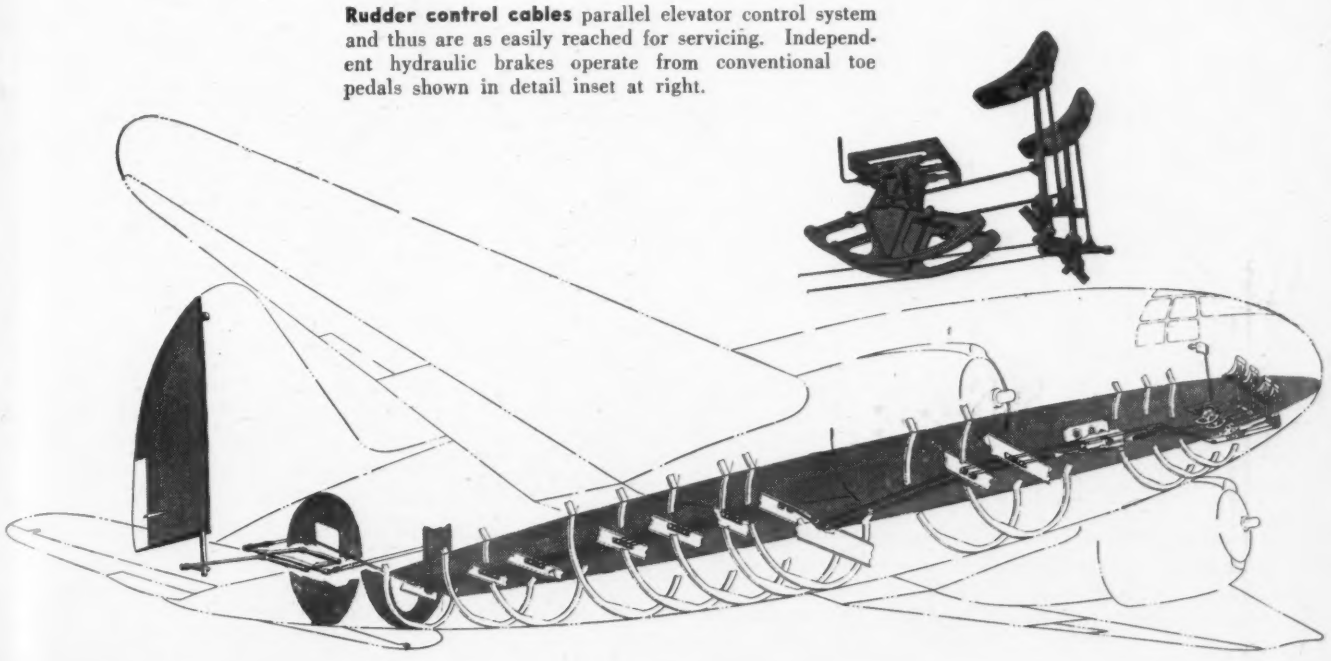
Rudder Design

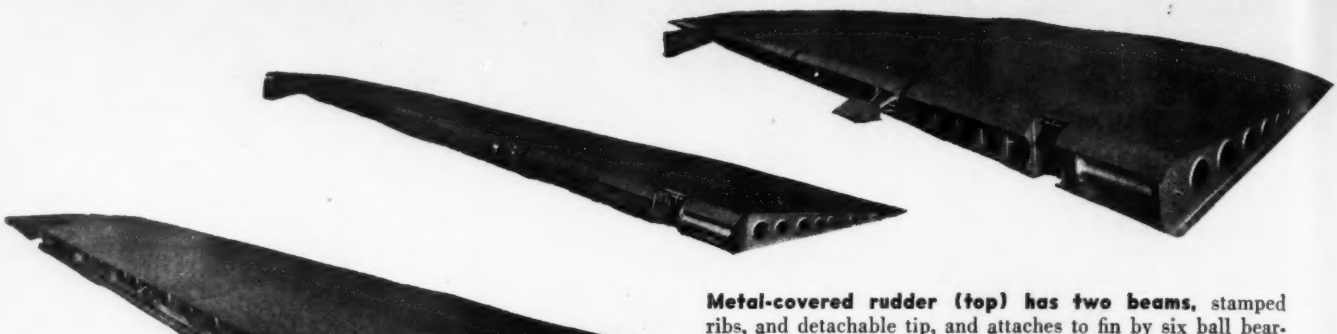
Like the elevators, the rudder has two beams and stamped metal ribs, 24ST Alclad covered. It attaches to the fin by six readily detachable ball bearing hinges. Its area is 52.8 sq.ft., and it swings 20 deg. both ways from the plane's center line. Dynamic balance is obtained by a streamlined weight mounted forward of the hinge line near the top. Actuation is by a steel torque tube bolted to the lower end near the hinge line extending down into the fuselage, where it attaches, near a ball bearing support, to a push-pull horn.

The rudder tab, accounting for approximately 13 percent of rudder area, is a combination trim and balance type with an area of 7.02 sq.ft., its length being 65.12 in. and maximum chord 16.65 in. As is the case with the other tabs, it is all metal and attaches by a continuous piano-type hinge.

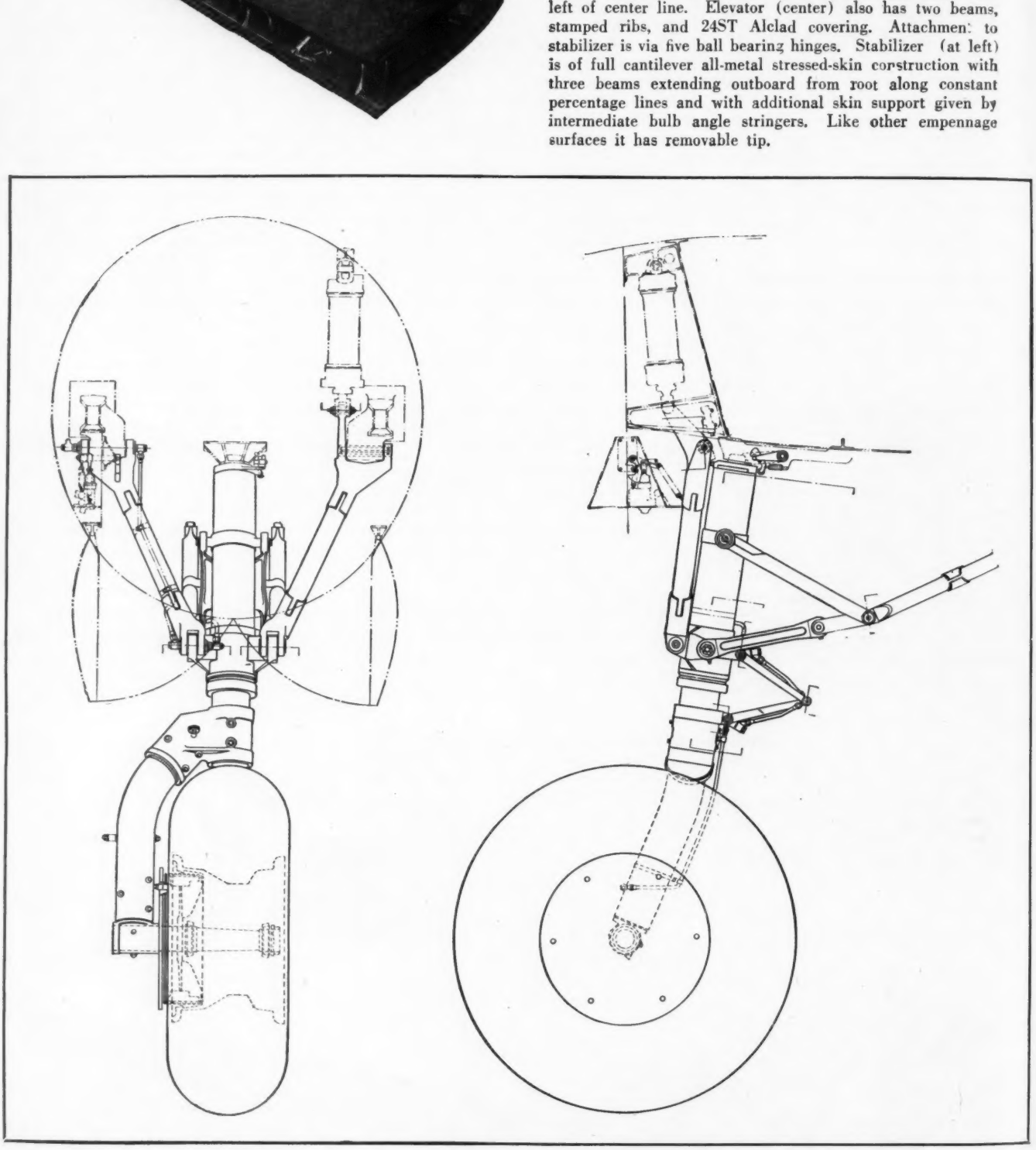
Another interesting and important example of design simplification to aid in both peace and wartime operation and maintenance is given in the landing gear. The opportunity to design and tool for large military production has made possible the simplification of the landing gear even though it has been strengthened to carry increased weight, for the *Commando* is often operated up to 52,000 lb. gross weight. On at least one occasion—outside of test flights—it has been flown at 60,000 lb. gross.

Rudder control cables parallel elevator control system and thus are as easily reached for servicing. Independent hydraulic brakes operate from conventional toe pedals shown in detail inset at right.





Metal-covered rudder (top) has two beams, stamped ribs, and detachable tip, and attaches to fin by six ball bearings. With 52.8 sq. ft. area, its arc is 20 deg. to right and left of center line. Elevator (center) also has two beams, stamped ribs, and 24ST Alclad covering. Attachment to stabilizer is via five ball bearing hinges. Stabilizer (at left) is of full cantilever all-metal stressed-skin construction with three beams extending outboard from root along constant percentage lines and with additional skin support given by intermediate bulb angle stringers. Like other empennage surfaces it has removable tip.



Although C-46 is consistently flown at twice design gross weight of prototype, landing gear is simple in design. Hydraulic retracting action, requiring less than 10 sec., is via vertical cylinder attached at top to front spar and nacelle bulkhead and at bottom to bell crank comprising part of outboard side brace strut. Hydraulically operated sequence valve operates two fairing doors.

The main units, having a tread of 25 ft. 11 in., consist of single Cleveland Pneumatic Tool Co. oleo pneumatic shock absorbers, braced fore and aft by tubular drag struts which are aligned by forged upper and lower drag links. Sidewise bracing is by similar tubes, and all tubular units incorporate forged terminal fittings.

Landing Gear Retraction

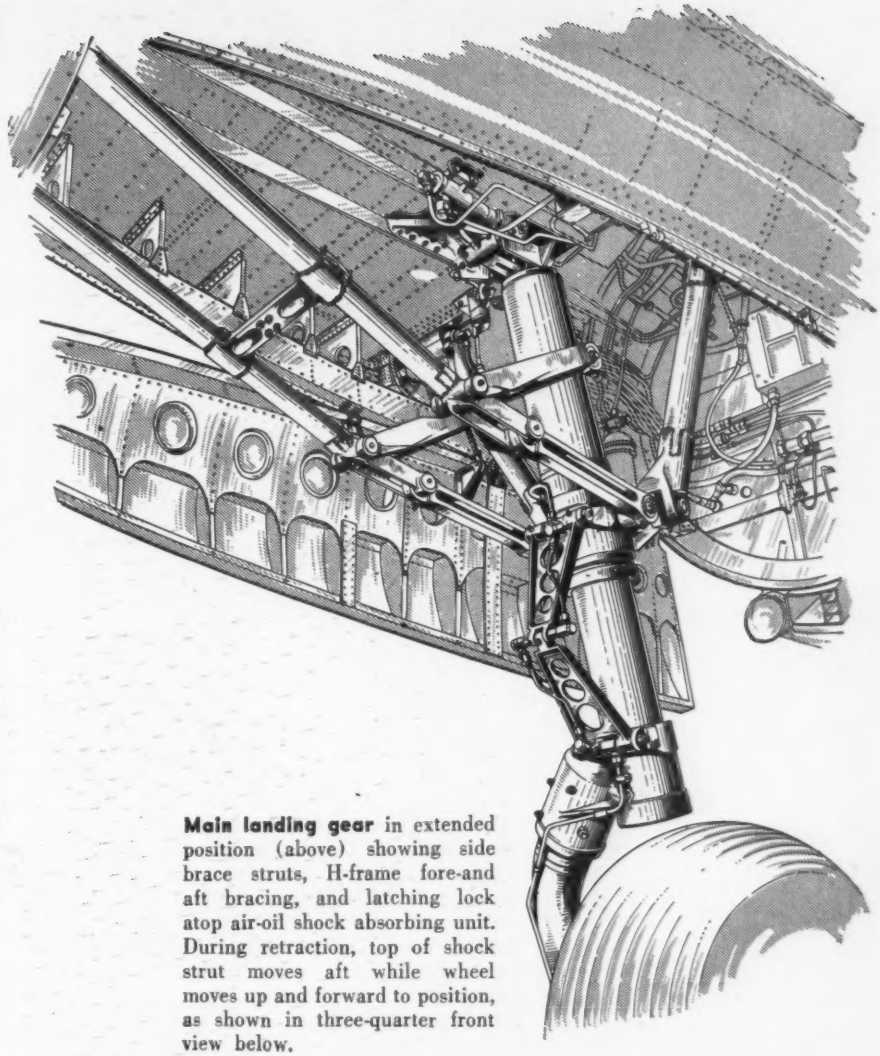
Hydraulically-operated retraction—taking less than 10 sec.—is as follows: The "down" latch at the top of the shock strut is first released and the upper end of the strut moves backward while the wheel moves up and forward, being guided into its position in the nacelle by the rear drag struts and drag links and side brace struts. Retracting action is imparted by the extension of a vertically-mounted hydraulic cylinder fastened at the top to a fitting attached to the front spar and nacelle bulkhead, and at bottom to a bell crank which is part of the outboard side brace strut. When fully retracted the gear is locked in "up" position by a latch. Two fairing doors, hydraulically operated through a sequence valve, follow the wheel up to enclose it completely in retracted position.

Emergency lowering of landing gear can be accomplished by an auxiliary manual extension system. A warning horn in the pilot's cabin blows if either throttle is less than one-quarter open when either wheel is not locked in full "down" position. The landing gear has been built so that the plane is not at a sharp angle in three-point position, for the main cargo compartment floor is but 9.5 deg. from horizontal, a feature designed into the plane to make cargo loading and unloading easier. Either wheel or three-point landings can be made with equal facility, depending on the pilot's preference.

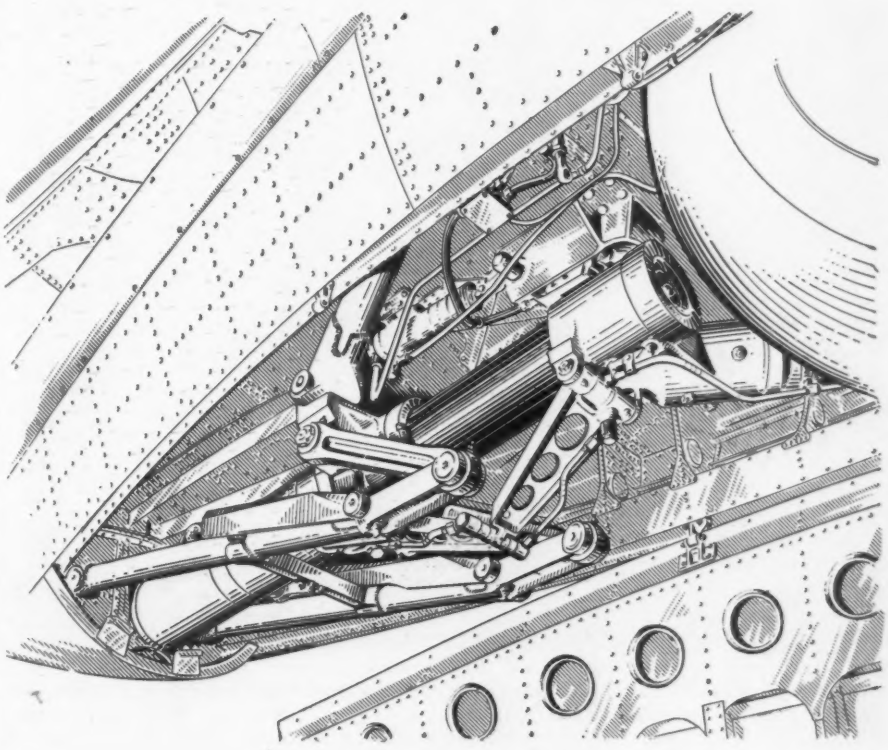
Main landing gear wheels are of magnesium alloy, with double expander type brakes operated by conventional rudder toe pedals from the main hydraulic system by means of a brake metering valve. Each wheel brake system is completely independent of the other. The parking brake is applied by pushing the rudder pedals down, pulling the parking brake lever back, then releasing the pedals to lock the parking brake.

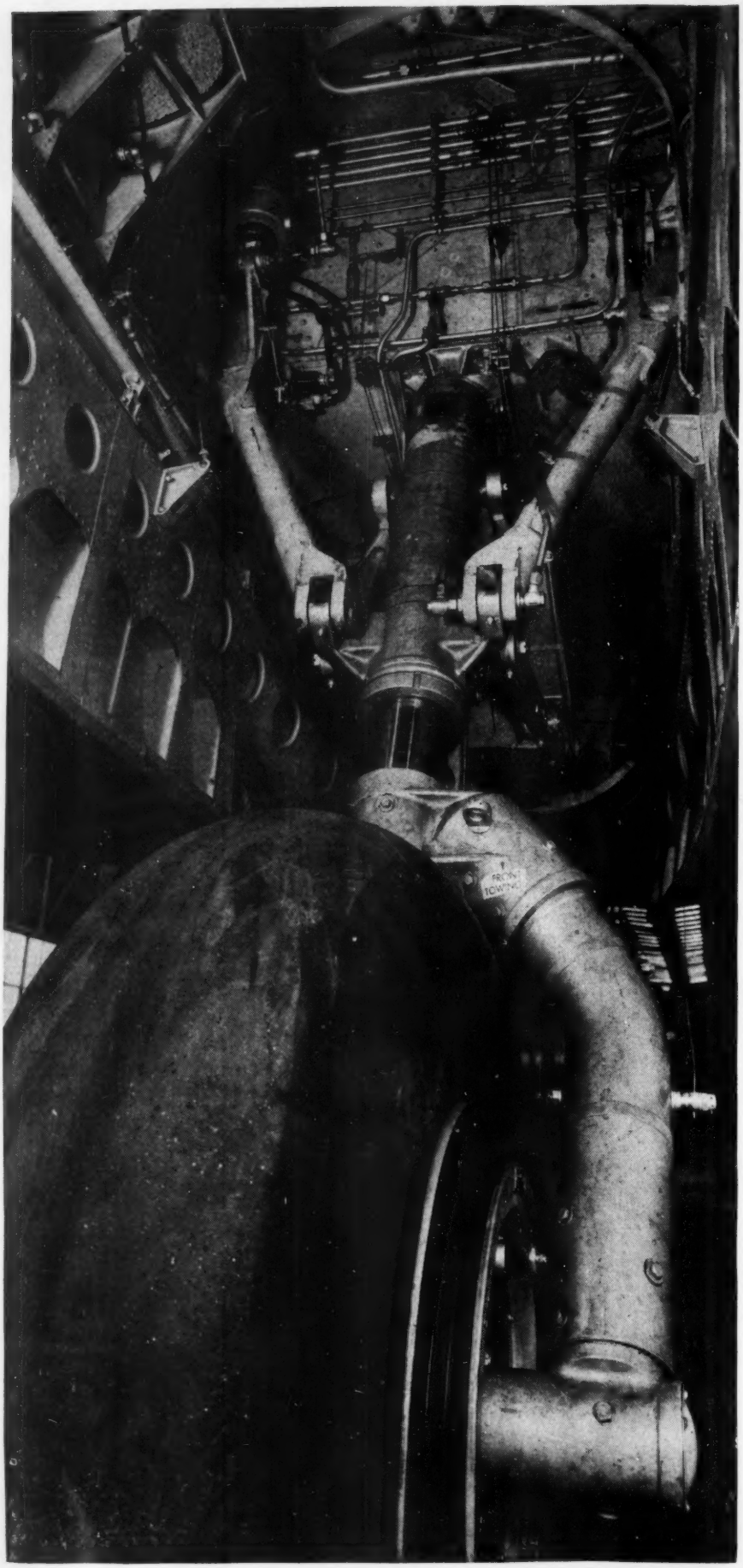
Tail Wheel Retraction

The tail wheel is a fully retracting, self-centering, swiveling shimmy-dampened shock strut suspended by a linkage mechanism within the tail cone. The axle is at the rear of a forged aluminum alloy fork which attaches to the shock strut at its mid-point and to a vertical arm at its forward end. The entire shock structure, which embraces the wheel, drag links, shock strut, and verti-



Main landing gear in extended position (above) showing side brace struts, H-frame fore-and aft bracing, and latching lock atop air-oil shock absorbing unit. During retraction, top of shock strut moves aft while wheel moves up and forward to position, as shown in three-quarter front view below.





Head-on view of nacelle shows hydraulic retracting cylinder and bell crank at upper left, forming part of outboard side brace strut. Ahead of side brace struts **are** smaller hydraulic units, with sequence valve, for closing fairing doors to enclose retracted wheel.

cal arm, swivels about an axis which does not change angular relationship to the ground line during shock absorber travel.

Retraction is back and up by following action of an upper and lower strut which is operated by a hydraulic cylinder. Two fairing doors make a complete enclosure, following the gear up by means of springs released by a trip.

Main landing gear tires are Goodyear 55x19.00–23 heavy duty, 55 lb. pressure type, and tail wheel is 24x10.00–7 10-ply heavy duty of the same pressure.

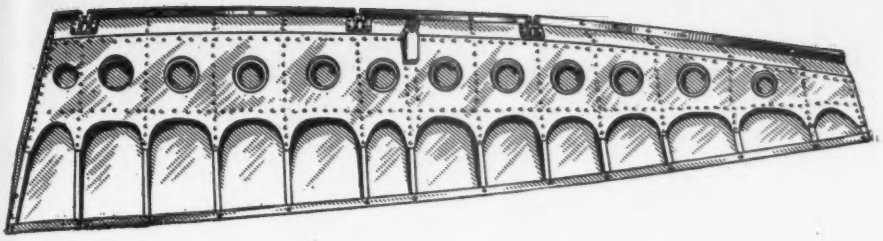
When the *Commando's* predecessor first went on the boards, design philosophy resulting from the three years' study called for the "fewest number of engines of the greatest horsepower available." In those days, 1,300 hp. plants were indicated, but as the plane has grown the power has gone up so that production models now carry two 2,000 hp. units—Pratt & Whitney R-2800-51's, swinging four-blade, full-feathering Curtiss electric propellers of 13 ft. 6 in. dia.

The engine control system, which is centered on the control pedestal between the pilots, consists of cables from the cockpit to the rear of the engines, with pushpull rods from there for all units except the propeller governor control, which has a cable actuating a flexible push-pull unit. The Curtiss-designed, Solar-built exhaust system is of stainless steel, reinforced at the joints. Collector rings and exhaust ducts have been designed with sufficient flexible joints to prevent undue expansion stresses. Each engine has its own carburetor air intake system which can increase incoming air temperatures at least 110 deg. F. above atmospheric temperature when operating at 65 percent power.

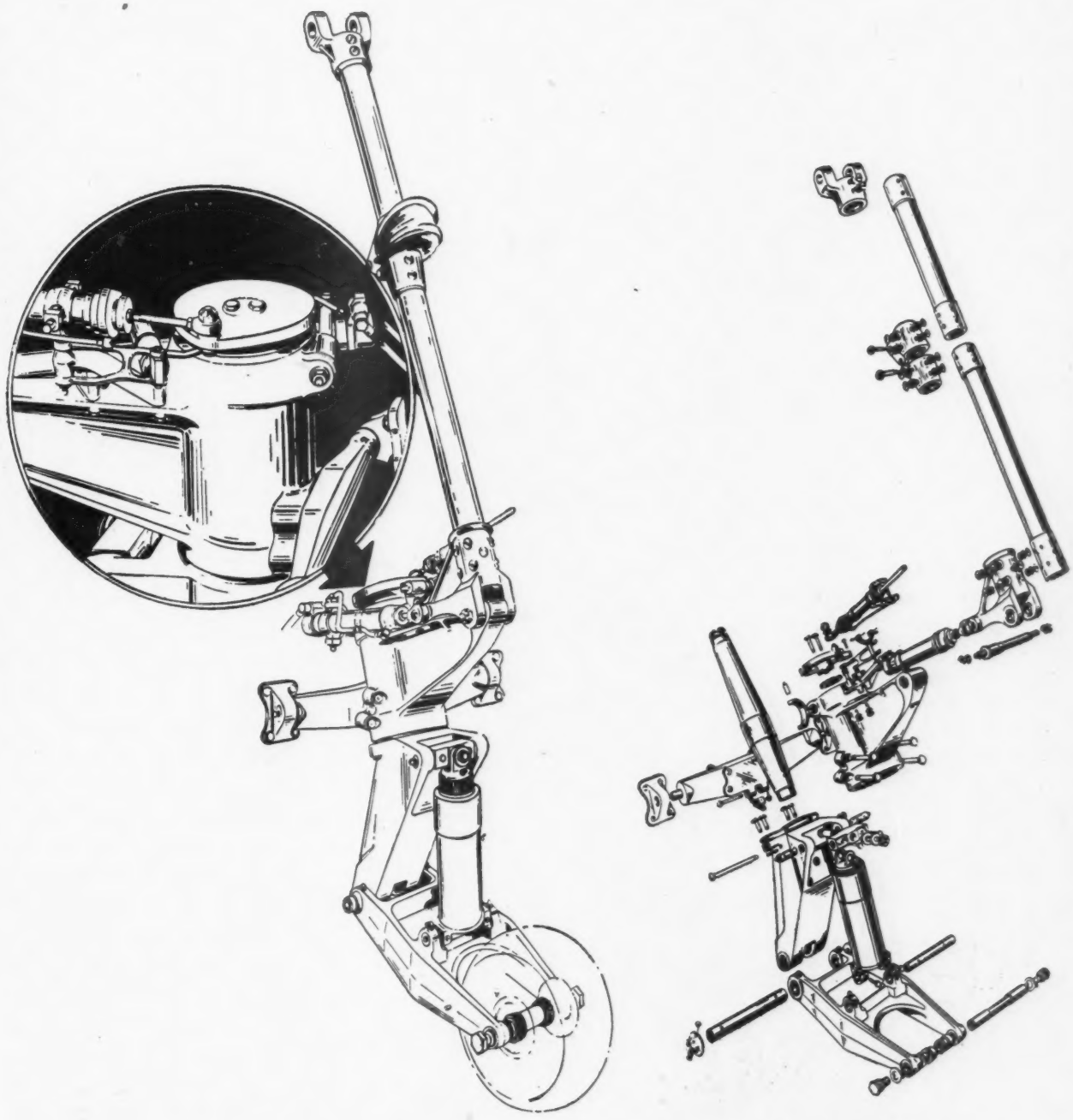
Performance Outstanding

For proof of the soundness of the basic philosophy calling for the "fewest number of engines of the greatest horsepower available" there are these performance figures: Loaded to a gross weight of 45,000 lb., the *Commando* has a top speed of 265 mph. at 13,000 ft. and a cruising speed of 227 at 10,000 ft. at 67 percent of rated power. Ceiling with one engine out of operation is 12,000 ft., and normal takeoff run to clear a 50-ft. obstacle is under 3,250 ft. Perhaps more important, however, are recent service reports from one war theater showing that the *Commandos*, consistently loaded to around 50,000 lb. gross, take off from a rough field at 6,200 ft. elevation and deliver their cargoes over routes where the ceilings flown reach up to 22,000 ft.

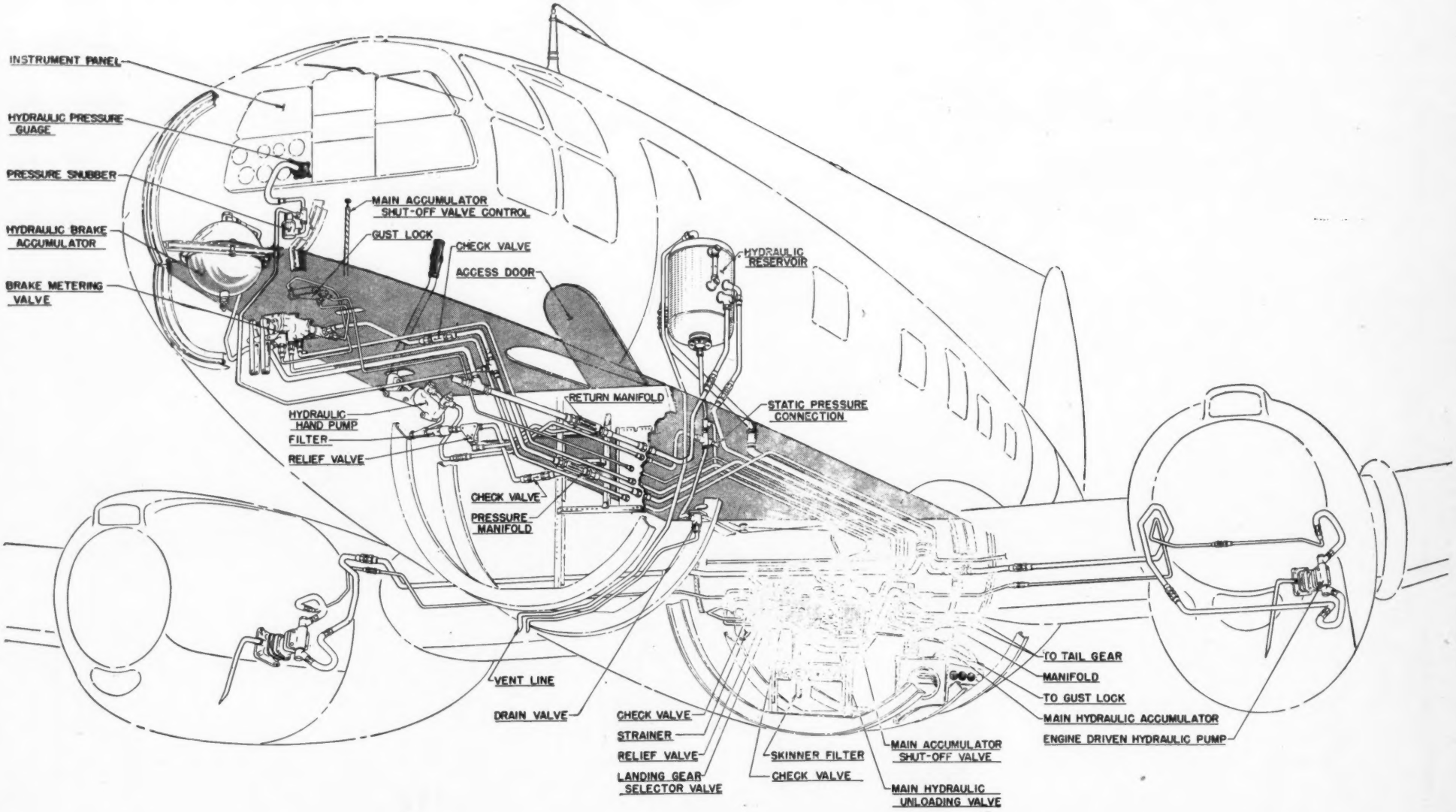
The main hydraulic system is of the accumulator type, comprising two engine-driven pumps, a check valve in the main pressure line to prevent loss of pressure, and two accumulators, one in



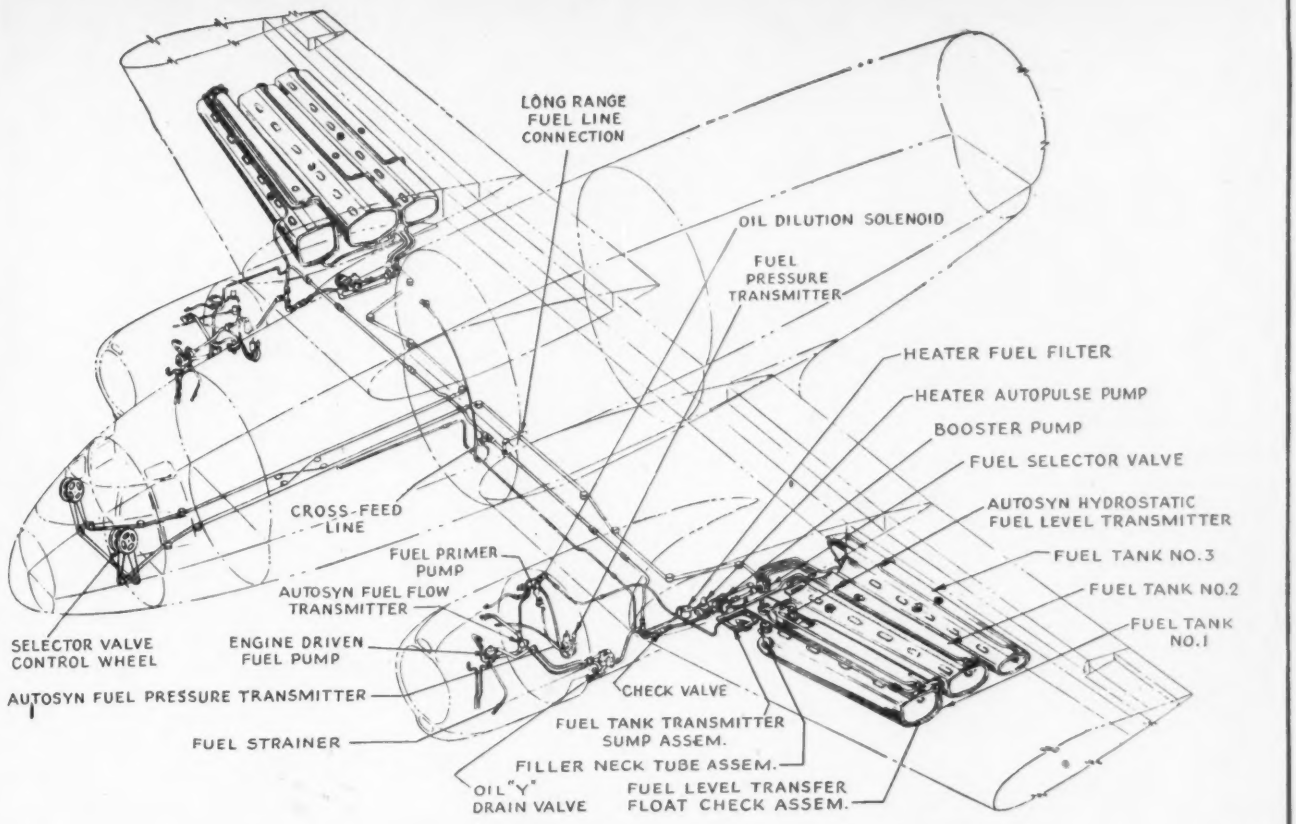
Right-hand half of main landing gear fairing (also shown at left and right in photo on opposite page) as it appears from inside, revealing design details.



Phantom view (above) and exploded view (right) of *Commando* tail wheel, with inset detail showing hydraulic shimmy damping unit. Like main gear, it is fully retractable. Entire shock structure, including wheel, drag links, shock strut and vertical arm, swivels about axis which does not change angular relationship to ground line during travel of shock absorber. Fairing doors, completely enclosing wheel in retracted position, are operated by trip.



Main hydraulic system includes two engine-driven pumps, check valve in main pressure line to prevent pressure loss, and two accumulators, one of which is located under floor in accessory compartment with reserve for brake system located above floor in pilots' cabin ahead of instrument panel. Normal pressure is 1,200 psi. for landing gear, brakes, surface controls, flaps, and cowl flaps, with automatic pilot operating at 150-200 through bleeder



Phantom view of fuel system. Manually operated cable controlled selecter valve, actuated by dual controls accessible to both pilots, permits selection of fuel from any desired tank in standard 1,400-gal. capacity system

the accessory compartment under the floor and a reserve for emergency brake operation located above the floor in the pilot's compartment. Check valves are also installed in the main pressure line from the engine pumps to provide normal operation of the system in the event of failure of one engine or pump. A fluid reservoir is located above the floor at the forward left-hand corner of the main cargo compartment and an emergency hand pump is set between the pilots just behind the control pedestal. All hydraulic system fittings are aluminum alloy, except on brake lines and special nacelle swivel and tubing assemblies, where they are stainless steel for structural purposes. Normal pressures are 1,200 psi. for landing gear, brakes, surface controls, flaps, and cowl flaps and. through a bleeder valve, 150-200 for the automatic pilot.

Control Boost System

Designs to make cargo handling easier involve even the hydraulic system, for it supplies power for a loading winch set in the main cargo compartment floor just behind the bulkhead aft of the pilot's cabin

When the *Commando's* prototype went into design, it was sought to keep pilot fatigue to a minimum through the use of a hydraulic boost system for all controls. This system, while an integral part of the control set-up, was designed to supplement rather than supplant, for all controls were direct-connected and so designed that failure of any one mechanical unit in either elevator, rudder, or ailerons would not result in loss of action of any other part of the system.

The hydraulic boost set-up, then, was designed to "cut in" on the system, the boost cylinders being located at the control horns of the various surfaces. It was ultimately developed to have a constant 3:1 ratio so that pilot's "feel" of controls was retained.

Since, however, the *Commando* has proved itself a stable, easy-to-fly craft, the theoretical considerations calling for the control boost have been found to be partially unnecessary. Too, wartime operation of constantly growing numbers of planes in every war theater embracing all conceivable climatic conditions means that maintenance is far different from peacetime airline operations from well established bases. These conditions, coupled with the fact that skills of vastly increased numbers of hurriedly trained men simply cannot equal the high levels of airline operation, call for elimination of every possible maintenance-requiring unit. Thus, the hydraulic control boost system for the rudder has been eliminated with this control now being straight manually operated.

Safety in Fuel System

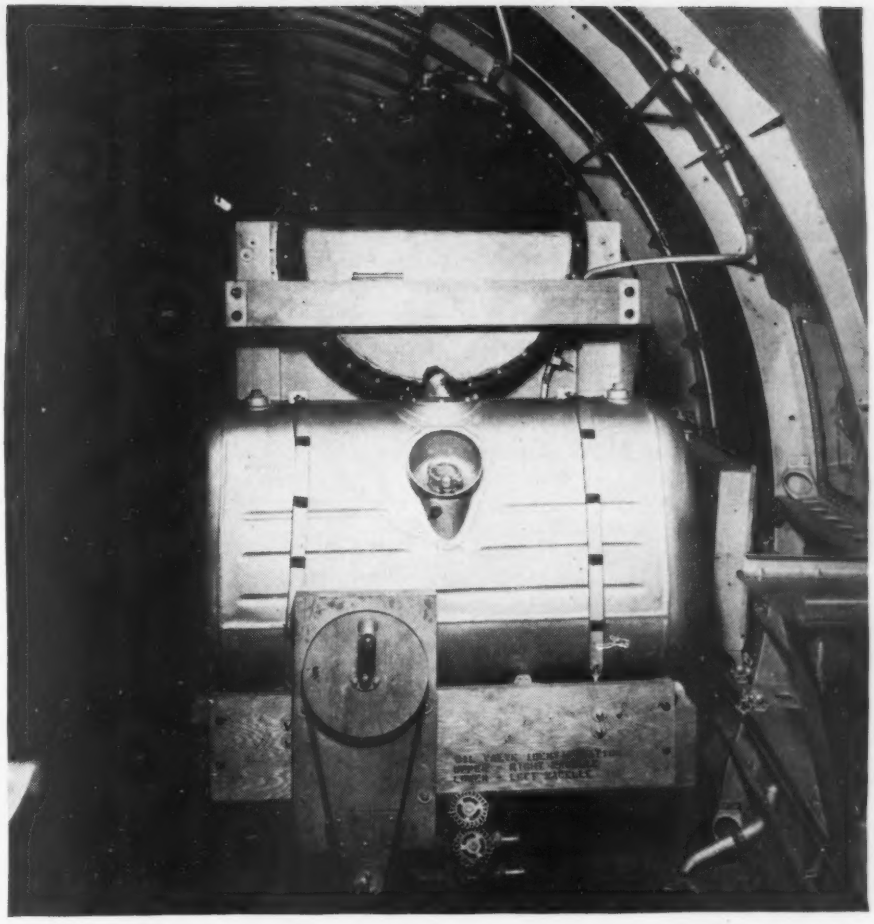
The electrical system follows conventional practice and design, consisting of two 24-v. batteries, two inverters for 400 cycle a.c. Components using electricity include: Power plants, radio, warning units, autosyn, instruments and, at present, heater units.

Safety was a prime consideration in original design of the fuel system, for tanks are all located well away from the fuselage in outer wing panels—outboard of the nacelles and the solid splice plate. Each engine has its own fuel system, but the two are interconnected by a cross-feed line.

All fuel tanks are aluminum alloy, with wing tanks being set in padded cutouts in the first and fourth ribs outboard of the splice panel. Ribs and supports are so designed that no flexing or bending can be transmitted to the tanks from surrounding structure. Fuel expansion of 3 percent of capacity is provided, and filler caps have

Phantom view of oil system, including fuselage tank installation for long range operation.

For long range operations, *Commando's* normal 1,400-gal. capacity may be increased by 800 gal. by installation of extra fuselage tanks mounted in lightweight plywood cradles. Here, in main cargo compartment, are shown one of the gasoline tanks and 39.8 gal. oil tank, with hand pump to transfer oil to regular oil tanks in engine nacelles.



pressure relief valves. Sump capacity is two pints per 100 gal., so designed that water or foreign matter cannot be taken into the tank outlet.

In the prototype, fuel went to the engine only from the fore tank via transfer pumps having a 7 gal. per min. capacity, accomplished by the pilot starting transfer pumps.

New Selector System

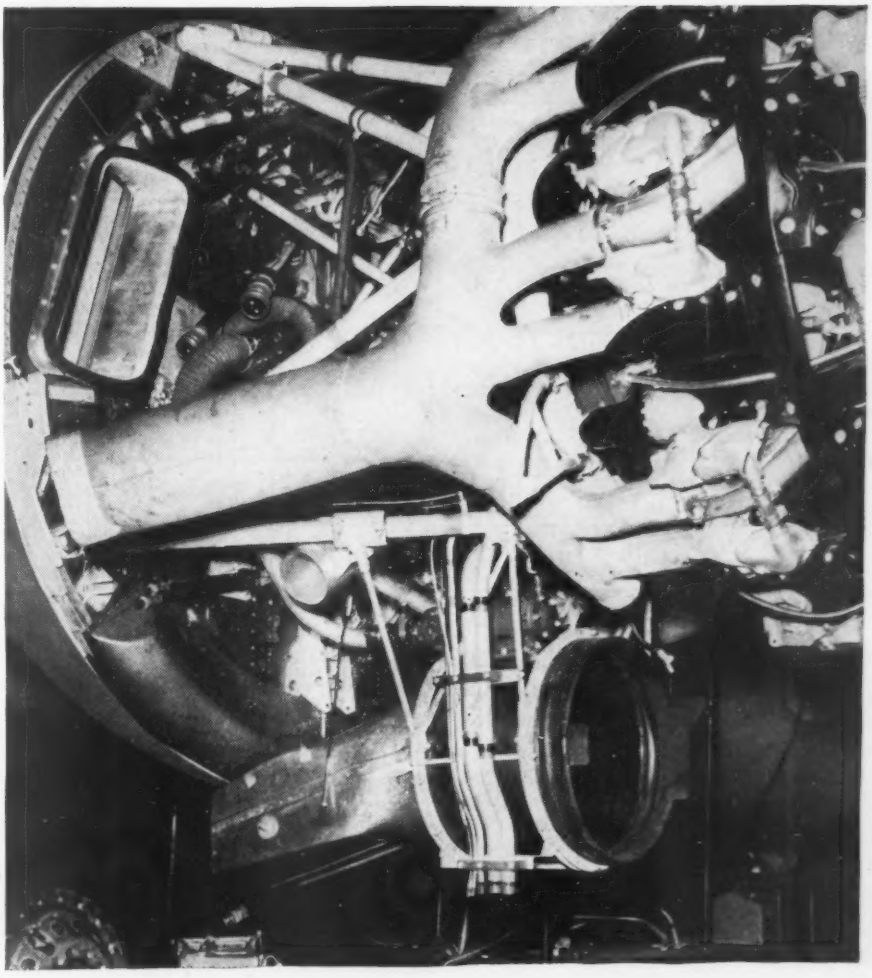
In C-40 production models, however, this has been changed so that a cable controlled selector valve, operated from dual controls, is accessible to both pilots, enabling them to select and draw from any tank. All fuel system pipes are 52SO aluminum, except for stainless steel cross feed lines and fittings.

Standard *Commando* fuel capacity totals 1,400 gal.—242 gal. in each of two fore tanks, 283 in the center tanks, and 175 in each of two aft tanks—and an additional 800 gal. may be carried in eight fuselage tanks for long range operations.

Separate oil systems are provided for each engine, the tanks having a capacity of 40 gal. each, with expansion space of 12½ percent of rated capacity. Tanks, set just aft of the firewall at the outboard side of the nacelle, are so arranged that expansion space cannot be filled while the tanks themselves are being filled.

Automatic Oil Cooling

Oil radiators are drum type, of 15 in. dia., mounted in the lower portion of the engine nacelle between the engine and the cowl flap. Each system has an automatic temperature control valve and provisions for oil dilution for cold weather starting. Added oil temperature control is obtained through controllable flaps in each exit duct. To facilitate maintenance, either the tanks or radiators may be removed with the engine and mount left in place.



View from below, showing installation of 15-in.-dia. drum type oil radiator mounted in lower portion of cowling between engine and cowling flap. Each oil system has its own flaps, operated individually from cockpit, for added cooling control.

Super-Aluminum Alloys For Aircraft Structures

Part I

By **KENNETH R. JACKMAN,** *Chief Test Engineer, Engineering Test Laboratories, San Diego Div., Consolidated Vultee Aircraft Corp.*

First of an important series giving design engineers invaluable information on weight saving techniques which can be applied on today's production lines. Initially considered is the new subject of artificially aging 24ST aluminum alloy.

NEVER IN THE HISTORY of mankind has the mechanical and technological side of industry moved so fast as in this year 1943. The war has, to be sure, accelerated the speed of invention and development, but even without the artificial impetus given by the armament race the technical advances would have been startling. One idea leads to another, one invention prompts a competing development, and in the pyramiding of machines and processes we trust that not only will the war be quickly won but that the ensuing peace years will find living made easier because of the "brewing" in our laboratory caldrons today.

To choose any particular development, out of the many bright spots appearing in university and industrial laboratories, might be presumptuous on the part of the writer, but since the topic of improved structural properties of the lighter aircraft materials appears to be foremost in engineering circles today, some of the latest startling developments in this field will be presented in this and following issues.

The ever-increasing output of dozens of mighty organizations, which today are producing and fabricating aluminum alloys for our warbirds, will tomorrow be applied to more efficient air transports, lighter cars, and new structures as yet undreamed of.

It is a far cry from the piles of aluminum saucepans and kettles in the city parks to the deadly *Liberator* four-engine bomber; from top speeds of 120 mph. of the last war to the 400 mph. streak of the *Thunderbolt* of this war. But this is no more wonderful than the advance possible in the field of structural properties of aluminum alloys. The 17ST Alclad aluminum alloy sheet of five years ago was considered an advance, with a design tensile yield of 27,000 psi. and an ultimate tensile stress of 50,000 psi. Today, we have 24ST Alclad sheet with a 37,000 psi. yield and a 56,000 psi. ultimate.

That 30 percent increase in the yield stress was hailed as a marked achievement in the aircraft industry, resulting in major structural weight savings on our present aircraft. In succeeding installments of this series, however, it will be seen that this same 24S Alclad aluminum alloy, used so universally today, can be depended upon to give tensile and compressive yields of 60,000 psi. and over—an increase of approximately 60 percent over the yield properties permitted in this alloy in present aircraft structures.

Still more wonderful is the fact that the transformation of the common 24S Alclad aluminum alloy into this new "superaluminum alloy" can be accomplished in current production lines and with no undue hardships.

The present public interest being shown in the "super-aluminum" alloys has probably evolved from a research program into the practical usability of artificially aged 24S aluminum alloys inaugurated and being carried on in the Engineering Test Laboratories, San Diego Div., Consolidated Vultee Aircraft Corp. True, the principles of strain hardening and of elevated-temperature

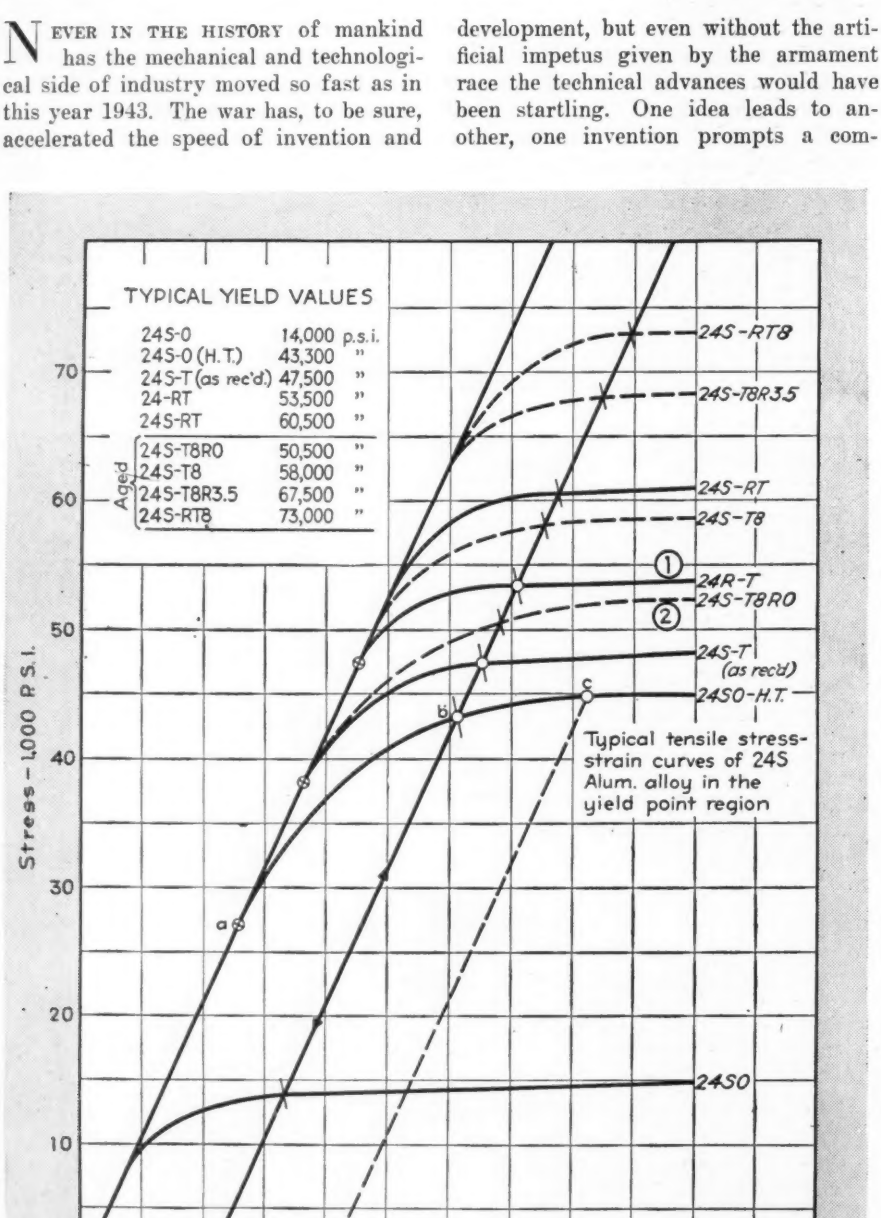


Fig. 1

aging are well known, having been considered in technical articles through many years. But it remained for these laboratories to first apply practically both these principles to aircraft production—following a thorough search into the numerous variables that might affect the material properties.

It has been the privilege of the writer to present the subject of the benefits of pre-stretching aircraft materials[5, 11] several times during the past few years, but it is believed that this series of articles is one of the first to discuss publicly the practical applications of artificially aged pre-stretched aluminum alloy material. Considerable pure research has been carried on in pre-stressing and aging certain aluminum alloys, as may be seen in the references given at the close of these articles, but the subject of artificially aging 24ST aluminum alloy is very new. So new, in fact, that it was not until the publicity given the early research reports of Miller, Tatman, and Weiher* that the benefits of this "super-aluminum" alloy became evident to the aircraft industry as a whole.

The "snowball," after receiving its initial push from San Diego, rapidly gained momentum, and the advances now being made comprise one of this decade's outstanding metallurgical achievements in the aircraft field.

It is interesting to look back at the origin of this experimental work in the Consolidated Vultee San Diego Test Laboratories. Early in the summer of 1937, and again in 1940, these test engineers were investigating the effect of heat on the physical properties of 24ST and on the color of its protective coatings. The visual evidence of overheating on painted aluminum alloy sheet is sometimes of prime importance in the analysis of the possible reduction of the material's physical properties following accidental fires such as occurred on the Martin *Mars* flying boat during its initial flight some years ago. It was while studying scorched test specimens, obtained by heating to various temperatures in an oven, that Tatman noticed the surprising increase, in the 300-400 deg. F. temperature range, of most of the mechanical properties of the 24S sheet at the expense of a little elongation.

Tatman and Miller investigated further, and both became so enthusiastic about the possibilities of the use of this "cooked" material in aircraft structures that it was not difficult to interest the Aluminum Co. of America and the U. S. Army Air Forces. In May, 1942, tentative approval was granted the Consolidated Vultee organization to make practical use of this "super-aluminum" alloy. In the months that followed, the Aluminum Co. and others added much to the early San Diego findings, and today the aircraft industry is just realizing the possibilities for the future of pre-stretched and artificially aged 24S aluminum alloys. Mozley,[20] of the Lockheed Research Laboratories, has published some recent Lockheed tests conducted on elevated temperature aging of 24S aluminum alloy which further substantiate the earlier findings of the consolidated Vultee Test Laboratories at San Diego. And Nock and Mears,[20] of the Aluminum Research Laboratories, have just presented the industry with valuable test data on aging of 24S.

Careful selection of materials is necessary, for a needless pound of metal in present-day bomber or fighter planes (or in the giant transoceanic cargo or passenger planes of tomorrow) reduces bomb or pay-loads and results in a constant consumption of horsepower with no effective return. The primary criterion

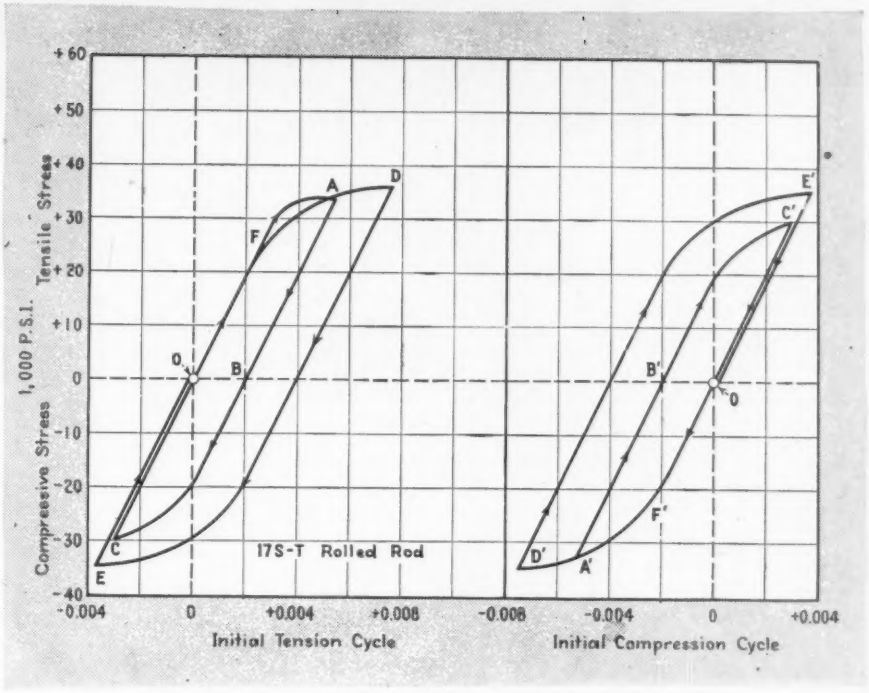


Fig. 2

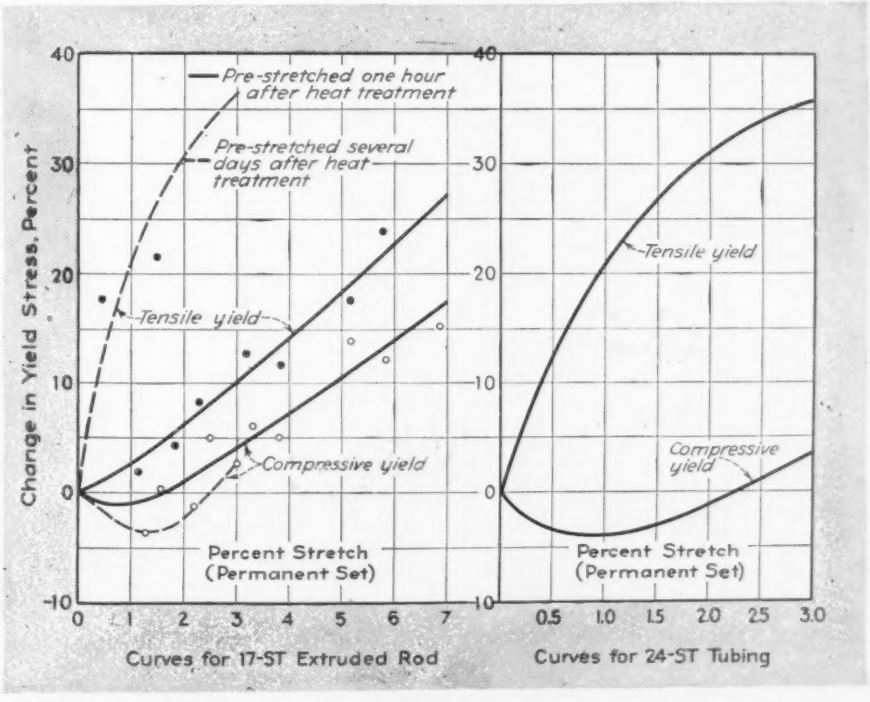


Fig. 3

*Roy A. Miller is chief structural research engineer and Max E. Tatman chief metallurgist of the San Diego Div., while Earl R. Weiher, formerly of the San Diego Div., is now chief metallurgist, Fort Worth Div.—all of Consolidated Vultee Aircraft Corp.

constantly considered by the modern aircraft designer is the strength-weight ratio of available materials. And today, especially, a material available for large-scale production is worth many times a superior material available in small quantities only in the research laboratory. The use, therefore, of the common 24S aluminum alloys to produce, by means of the transformation processes, the "super-aluminum" alloys, meets the immediate demand of the aeronautical engineer and aircraft designer.

To help visualize the possible transports of tomorrow, it may be interesting to analyze a probable 1945 New York-London or San Francisco-Hong Kong 200-passenger *Altiliner*. Present indications point to a six-engine passenger landplane, possibly of the pusher type, having a gross weight of approximately 275,000 lb. Efficient design necessitates that useful load on such a sky giant be over 50 percent of the total weight, therefore the weight empty might be 135,000 lb.

A little more gazing into the "crystal ball", may show that the wing structural group of this airplane will probably weigh 40,000 lb.; the fuselage structure 17,000 lb.; the landing gear 18,000 lb.; the power plants and controls 45,000 lb.; the tail surfaces 3,500 lb.; and the furnishings, seats, etc., approximately 10,000 lb.

Table I shows the possible structural weight distribution in tomorrow's 275,000-lb. *Altiliner*. The wing, fuselage, and tail groups—which total approximately 60,000 lb. on the basis of modern conventional materials—will provide a fertile field for structural weight-saving through the use of more efficient materials. Present-day four-engine aircraft of approximately 50,000 lb. gross weight use nearly 12,000 lb. of aluminum alloys. If similar percentages of the various forms of aluminum alloys are used in our 1945 transport, the weight breakdown might be that shown in Table II.

TABLE I—Possible Weight Breakdown of Chief Structural Components of a 275,000-Pound "Altiliner" of 1945

Item	% Group weight	Weight (lb.)	Item	% Group Weight	Weight (lb.)
Wing Group	100.0	40,000	Fuselage Group	100.0	17,000
Spars	14.0	5,600	Longerons	9.0	1,530
Ribs and bulkheads	10.0	4,000	Stringers—longitudinal	8.0	1,360
Stringers	16.0	6,400	Stringers—circumferential	6.0	1,020
Metalskin	35.0	14,000	Bulkheads	10.0	1,700
Fittings	3.5	1,400	Metal skin	18.0	3,060
Rivets, bolts, nuts	1.5	600	Fittings	3.0	510
			Wing—fuselage attachments	3.0	510
Tail Group	100.0	3,500	Totals (wing, tail, and fuselage)	100.0	60,500
Spars	20.0	700	Spars and longerons	13.0	7,830
Ribs	20.0	700	Ribs and bulkheads	10.6	6,400
Stringers	6.0	210	Stringers	14.9	8,990
Metal skin	25.0	875	Metal skin	29.7	17,935
Fittings	5.0	175			

Fig. 4

Of course it must be realized that the right distributions between drawn sections made from Alclad strip stock and extrusions, between forgings and castings, or between rivets made of 17S wire, spot welds, "cycle-weld," or "Metlbond" vary with each manufacturer and with each model. Tables I and II will, nevertheless, give the readers—as the joint designers of this 1945 sky giant—something tangible to study.

How can this structure be lightened? It is obvious that in such a large aircraft magnesium can in many instances be efficiently substituted for aluminum, especially in the castings and forgings. However, the major portion of this 275,000-lb. giant must still be fabricated, as today, of Alclad sheet or strip stock, unless the use of steel and stainless steel for such large aircraft proves to be far more economical than present trends would indicate.

It is economical, in overcoming corrosion problems in transoceanic transports, to use Alclad sheet for outer skin, stiffeners, and structure. Alclad strips in drawn stiffeners will therefore replace many extruded sections. Drawn or rolled sections have the added advantages of local manufacture, versatility of gage, and cheapness of fabrication. However, both rolled and extruded stiffeners, together with the wing skin and the attaching structure, may be given high mechanical properties by either cold work or elevated-temperature aging, or a combination of both. Therefore these structural sections will be the focal point in this weight-saving venture.

Effect of Cold Work on Aluminum Alloys

First consider the effects of prestressing 24S aluminum alloy on its stress-strain curve. Fig. 1 shows the stress-strain curves in the yield region for several common 24S aluminum alloys. Curve 1 represents conventional 24ST aluminum alloy in its "as received" condition, after having undergone some cold work during the process of flattening and straightening the sheet during manufacture. This heat-treated sheet is difficult to form, and it has too much spring-back for assembly into many aircraft structural members, such as bulkheads, wing ribs, spar flange angles, etc. It must, therefore, be annealed before forming. A subsequent heat treatment of such hydropressed structural members—which permit little or no cold working because of their inherent shapes—will remove the "knee" of Curve 1 and will more nearly approximate Curve 2.

If, however, the member is of such shape and size as to permit loading in tension, the stress-strain curve could then be extended even beyond the pro-

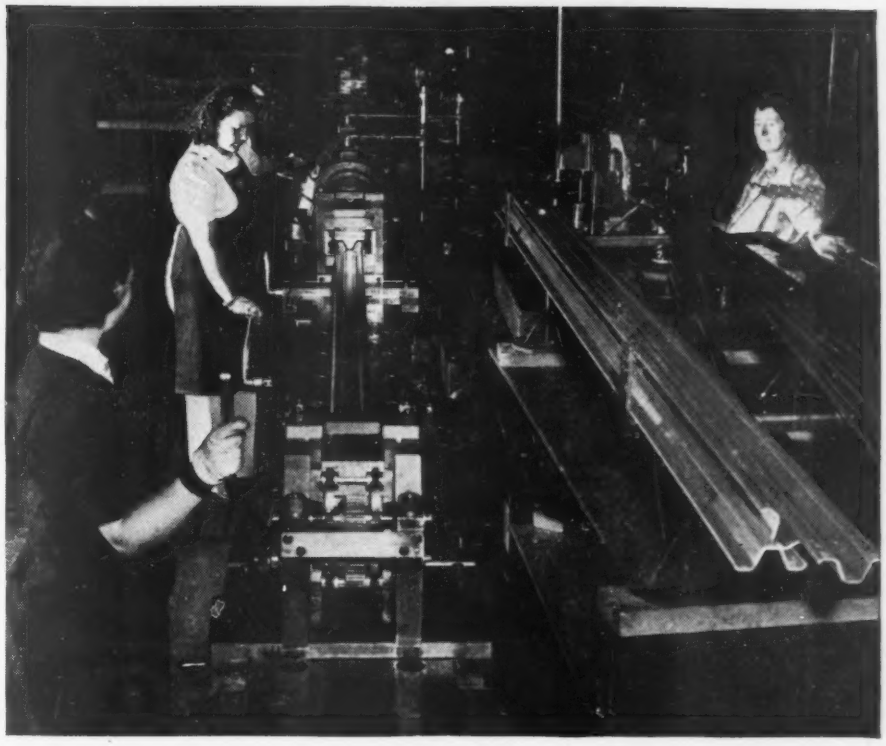
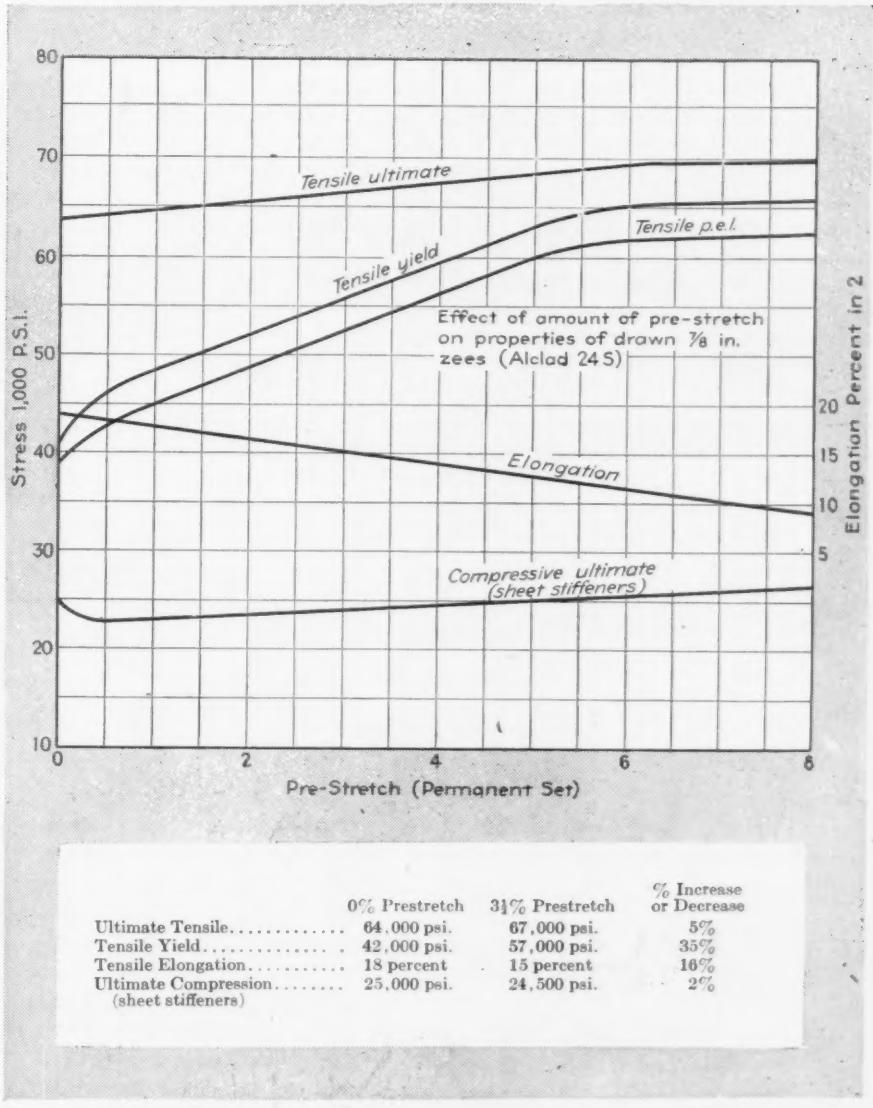


Fig. 5



	0% Prestretch	3½% Prestretch	% Increase or Decrease
Ultimate Tensile	64,000 psi.	67,000 psi.	5%
Tensile Yield	42,000 psi.	57,000 psi.	35%
Tensile Elongation	18 percent	15 percent	16%
Ultimate Compression (sheet stiffeners)	25,000 psi.	24,500 psi.	2%

Fig. 6

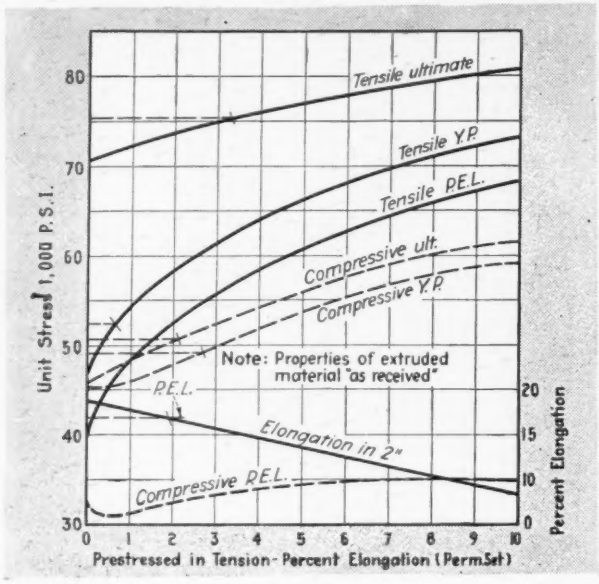


Fig. 7

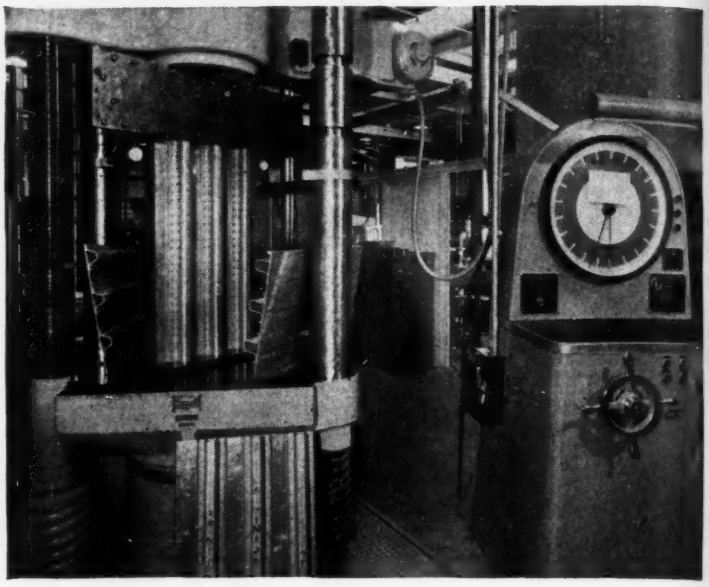


Fig. 8

portional elastic limit *a* of Curve 2, to some point *b*. The proportional elastic limit of the heat-treated 24SO sheet has thereby been increased from 27,000 psi. to approximately 43,000 psi. Release of this tensile load will permit the stress-strain curve to drop along line *bo'*, to produce a permanent set of 0.002 in./in. A second tensile application of load to the member would cause the stress-strain relationship to backtrack up line *o'b*, reaching point *b*, and then to continue along the conventional 24ST curve. The cold-working procedure and the repeated loading of the member could quite evidently be controlled so the definite "knees" *b* and *c* of Curve 2 —so characteristic of cold-worked material—could be made to arrive at the stress (say 45,000 psi.) just slightly below the proportional elastic limit of the 24RT material. Raising or lowering of the yield point by cold working or heat treatment may be seen, therefore, to be a reversible process, governable by the operator.

Another viewpoint is that cold working 24S material results in translating the characteristic "knee" to the right—in other words, in offsetting the original zero strain to the right an amount equivalent to the permanent set (*O-O'* in Curve 2 of Fig. 1).

It thus becomes evident that the cold-working characteristics of a material are limited only by the original ductility of the material, in terms of the elongation at failure. At point *c* of Curve 2 only 0.004 in./in., or 0.4 percent of the expected 17 percent total elongation of this 24ST sheet has been sacrificed to gain approximately 17,000 psi. Inasmuch as many aircraft structural designers believe that 3 to 5 percent tensile elongation is allowable for most design conditions, it is obvious that the pre-stressing process could be continued on Curve 2 of Fig. 1, far to the right of the plotted area, with additional increases in the mechanical properties.

TABLE II—Possible Material Weight Distribution in a 275,000-lb. "Altiliner" of 1945

Material or Part	Form	Symbol	Weight, lb.	Total
Aluminum Alloy				
Aluminum	Bars, sheet, tube, wire	2S	100	
Aluminum Alloy	Bars, extrusions	24S	2,100	
" "	Extrusions, tube, wire	17S	2,500	
" "	Sheet, tube	52S	2,000	
" "	Extrusions	53S	200	
" "	Castings (die)	#13 & #218	300	
" "	Castings (sand)	'95T4	1,000	
" "	Castings (sand)	220T4	100	
" "	Castings (sand & perm. mold)	356T6	400	
" "	Forgings	17S–T	200	
" "	Forgings	14S–T	2,000	
" "	Forgings	A51S–T	100	
" "	Sheet and strip	24S & 24S–RT	39,000	
	Total Weight—Aluminum Alloys			50,000
Steel				
Steel—Chrome moly	Bar, sheet, tube	X4130	2,200	
" —Chrome moly	Castings	X4130	200	
" —Chrome moly	Forgings	X4130	1,400	
" —Stainless	Bar, sheet, tube	18–8	1,200	
" —Stainless (stabilized)	Sheet, tube	18–8	600	
" —Miscellaneous type	Bar, sheet, wire		400	
	Total Weight—Steel			6,000
Miscellaneous Raw Materials				14,000
Miscellaneous Standard Parts	Pumps, Instruments, etc.			20,000
Engines, Propellers, Accessories				45,000
	Weight, Empty (Total)			135,000

Investigations of Cold-Working Phenomena

Messrs. Templin and Sturm,[13] of the Alcoa Research Laboratories, have presented some very interesting relationships of stress-strain curves obtained by alternate cyclic operations in tension and in compression. Fig. 2 illustrates the results obtained by tensile and compressive overloadings of 17ST rolled rod.

At the left of Fig. 2 are shown a family of stress reversal curves, starting with tension at *O*, and following the characteristic curve to *A*. At this point, the load is released, and the curve falls parallel to the original modulus line to intersect the horizontal axis at *B* with a permanent-set strain of approximately 0.002 in./in. At point *B* the load is shifted to compression, and the loading continues down to *C*.

A release of the compressive load brings the stress-strain curve back to its original value by again following a path parallel to the original modulus line. This closure of the hysteresis curve was, of course, not happenstance, since the compression load *C* was chosen

(*Turn to page* 163)

The B.F. Goodrich Airplane of the month

CURTISS COMMANDO

SHOUTING "GERONIMO," American Paratroops drop on vital installations behind enemy lines. They get there fast . . . and in force . . . in great C-46 Army Transports known as "troopships of the sky." Because of their ability to transport Jeeps, supplies, and field artillery as well, Curtiss Commandos are among the most potent weapons in the United Nations' war bag.

Many B. F. Goodrich products fly with the winged army. Silvertown Tires and ET Brakes mean better ground control; De-Icers mean safety in icing conditions; and Bullet Sealing Fuel Cells mean protection from enemy action.

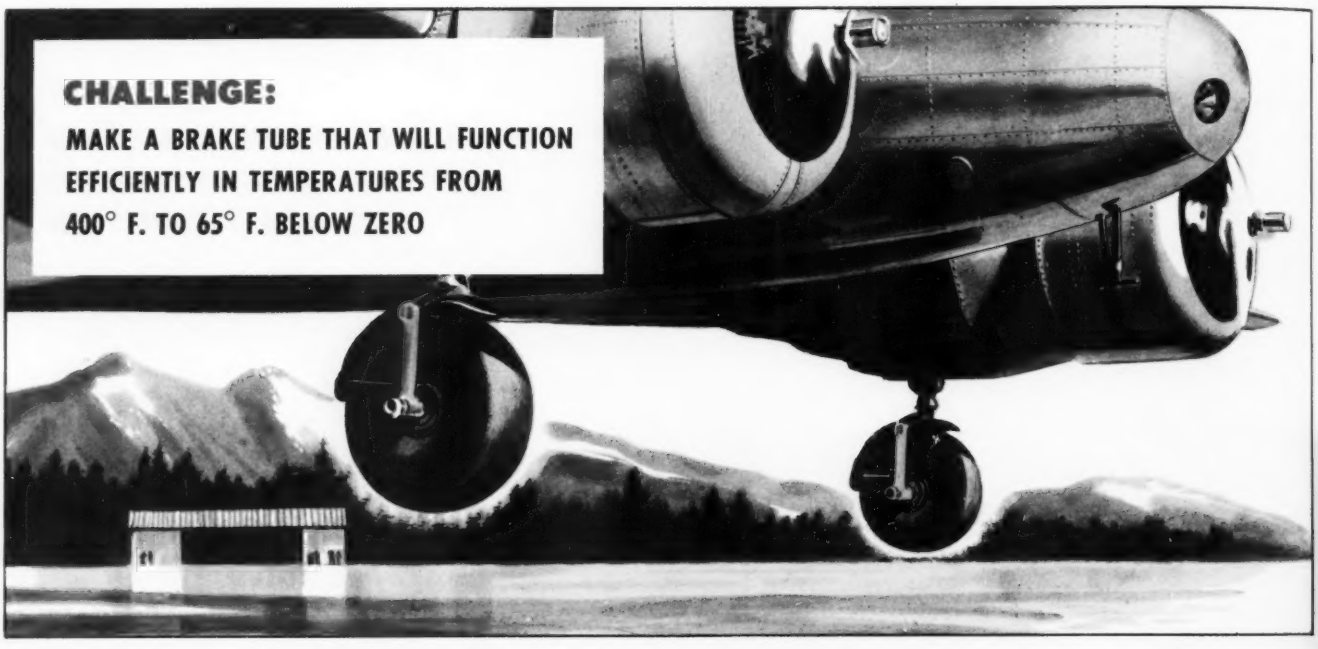
For the brilliant part it has already played in war theatres, and for its promise of even greater future performance, B. F. Goodrich salutes the Curtiss Commando—Plane-of-the-Month!

In war or peace

B.F.Goodrich

FIRST IN RUBBER

B.F. GOODRICH RUBBER RESEARCH FOR THE *Aviation industry*



THE NEW Air Corps specification was clear enough. It said that from now on expander tubes for ET brakes must operate efficiently in any temperature ranging from about 400° F. to 65° F. below zero. That was the challenge to B. F. Goodrich engineers.

The high temperature figure wasn't a problem. Expander tubes were already made to stand that temperature because of the terrific energy and heat they must absorb in stopping heavy, fast-landing planes. The real challenge was the 65° F. below zero figure. Expander tubes had been acceptable before if they functioned efficiently at −40° F.

The effect of this intense cold on all rubber is to make it brittle and cause it to crack when flexed. Since the main component of an expander tube is synthetic rubber, and since the tube must flex to function, the tendency to crack at low temperatures had to be overcome. And there was another problem. The oil, which had been changed in the brake tube to obtain better flow at low temperatures, was more destructive. To lick these problems a completely new brake tube was needed.

B. F. Goodrich engineers met the challenge two ways: First, a change was made in the shape of the tube opening (see opposite page), which meant that less flexing of the cold tube was required for efficient operation. This greatly relieved the strain on the tube and reduced its tendency to crack at the edges. But the problem of brittleness was still a factor, and the effects of the new, more destructive brake fluid still had to be overcome. This meant a completely new synthetic rubber compound was needed.

Calling on their long experience in compounding synthetic rubber compositions, B. F. Goodrich chemists worked out a combination of synthetic rubbers which they believed would give the necessary resilience at −65° F., work efficiently up to 400° F., and resist the destructive effects of the new brake fluid. Sample brake tubes were made of this compound and tested as shown on the opposite page. The results of these tests (which were more severe than those prescribed by the Air Corps) proved that the new B. F. Goodrich Compound could meet Air Corps specifications.

This is just one more example of the way B. F. Goodrich engineering and research meet changing requirements quickly . . . and come through with the satisfactory solution.

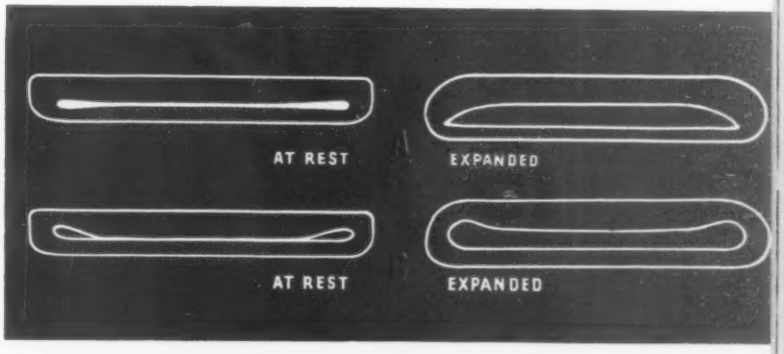
MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES

ARMY E NAVY
Awarded to seven plants

Changes in compounding and tube construction mean

BETTER BRAKING AT 65° BELOW

Change in shape of tube opening greatly improved its operating efficiency at low temperatures. As shown at right (A), brake tubes used to have a completely flat opening. As a result, excessive strain was concentrated at the edges when the tube expanded. This caused cracking—especially at low temperatures—and eventually led to complete rupture. To solve this problem, B. F. Goodrich engineers changed the shape of the tube opening (B) to leave small bulges at the edges, which increased the arc at each edge. Thus flexing and strain at the edges were reduced considerably, and one of the main causes of tube failure at low temperatures was eliminated.

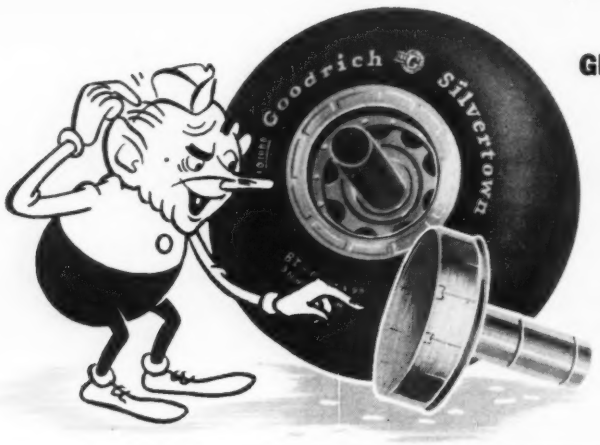


New compound put through grueling performance test: Sample expander tubes made of a new synthetic rubber compound developed in B. F. Goodrich Laboratories were first placed in a hot drum (1) at 400° F. for 24 hours. During this time they were flexed 4,400 times with normal brake clearances. Then the tubes were transferred to a cold box (2) at –65° F., kept there 72 hours, then flexed 12 times. The cycle was repeated, and upon completion, the tubes were dissected to see if failures had started at any points. No failures were found.

In war or peace

B.F.Goodrich

FIRST IN RUBBER



GEORGIE GREMLIN STRAINED HIS BRAIN ON THIS

BRAKE QUIZ

CAN YOU SCORE 100%?

Complete the ten statements by simply picking the one correct part (a, b or c) following each numbered statement. See if you can get them all.

1. Expander tube brake clearances should be kept between 15-1000ths and 65-1000ths of an inch because . . .

a. Higher or lower clearances cause gremlinitis.
b. Clearances under 15-1000ths cause excessive drag; over 65-1000ths impair brake efficiency.
c. Improper clearances cause "tube spin."

2. Excessive drag should be guarded against because . . .

a. Drag causes overheating, which may lead to tube failure.
b. Drag causes ugly skid marks on runways.
c. Drag upsets pilots' nerves.

3. Expander tube brake frames should be inspected every 100 hrs. for cracked or broken torque lugs because . . .

a. Broken lugs should be contributed to the scrap drive immediately.
b. Broken lugs may seriously damage lining.
c. With damaged lugs brake might overexpand.

4. In every 100-hr. check-up, you should pay particular attention to an E. T. brake's retractor springs because . . .

a. Damaged springs cause improper brake pressure release and result in drag.
b. A retractor spring is very interesting.
c. It is important to see if spring is retracted.

5. The condition of the expander tube should be checked every 100 hrs. to . . .

a. Look for any signs of cracking, which would lead to tube failure.
b. See if its air pressure is holding up.
c. Check its basic resilience ratio.

6. Brakes should never be operated when wheel is removed from axle because . . .

a. It's against regulations.
b. It will harden the brake controls.
c. It will cause severe damage and result in brake failure.

7. Specified type of brake fluid should always be used because . . .

a. Wrong fluid might corrode the brake drums.
b. Wrong fluid might have wrong compression.
c. Wrong fluid will cause excessive swelling of rubber parts and result in erratic brake operation.

8. Brakes should be bled for trapped air because . . .

a. Trapped air causes tube oxidation.
b. Soft action will result if not bled properly.
c. Trapped air throws wheels out of balance.

9. Hydraulic fittings, connections, and lines should be checked for leakage daily because . . .

a. Leakage results in poor brake performance.
b. Hydraulic fluid is expensive; we can't afford to let it leak away.
c. Leaking fluid will damage the wheels.

10. Bearing cones and cuffs should be thoroughly cleaned and repacked with grease every 100 flying hours because . . .

a. The crew chief says this is a "must."
b. Any dirt or chips present will cause serious damage to the bearings.
c. Gremlins hang out in the cones and cuffs and must be removed.

WHAT IS YOUR SCORE?

Each correct answer counts 10. 1-b, 2-a, 3-b, 4-a, 5-a, 6-c, 7-c, 8-b, 9-a, 10-b.

This is one of a series of maintenance quizzes prepared for ground crew trainees of the U. S. Army Air Forces Technical Training Command. It is our hope that this series will help all maintenance men get maximum service, safety, and efficiency from military, commercial, and civilian aviation equipment.

B. F. GOODRICH, AERONAUTICAL DIVISION, AKRON, O.

Skyway or Highway

B.F.Goodrich

FIRST IN RUBBER

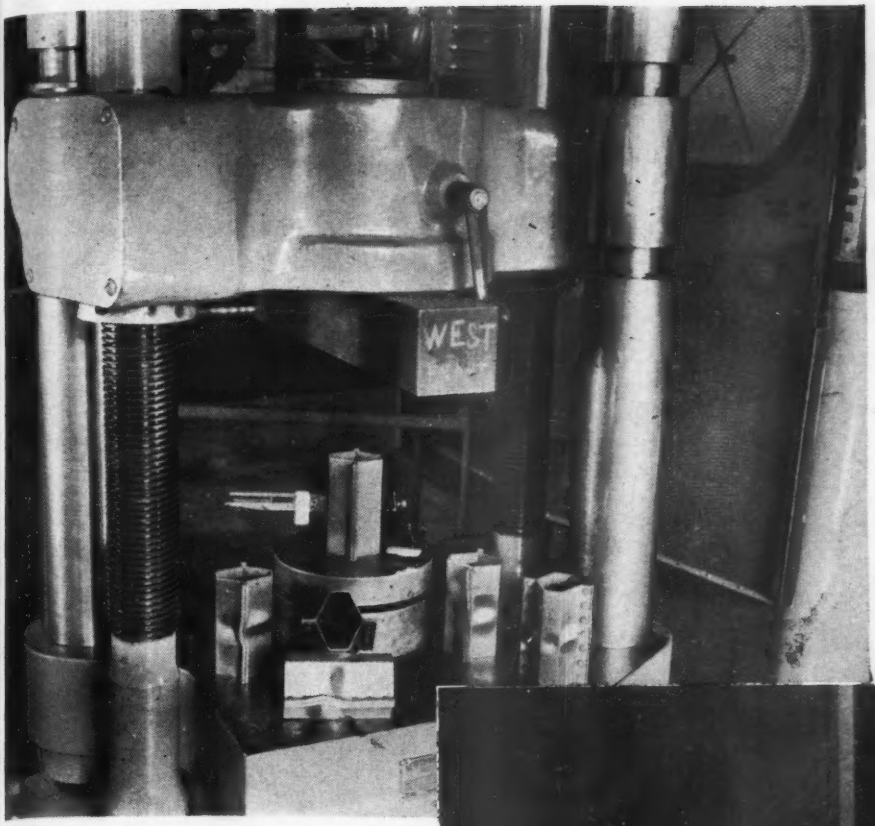


Fig 9

in relation to the tension load *A* that the stress-strain curve would return to its origin, *O*. The tension cycle might again be repeated to a load *D*, be relieved, be compression loaded to *E*, and again be returned to *O*.

The compression cycle might first have been completed—as shown by the curves on the right side of Fig. 2—followed by a tension cycle such that the loops would close, and the slope of the straight portions of the curves, or modulus line, would again be constant in both compression and tension. Several interesting facts have been presented in these Alcoa tests:

(1) The "cold-work knee," caused by the initial "as received" cold work in the rolled bar, appears only on the original tension cycle at *F*.

(2) The loops may be closed within experimental accuracy, and the curves will exhibit the previously-mentioned reversible reactions.

(3) The modulus of elasticity apparently is the same in both tension and compression.

Templin and Sturm [12] have also presented the interesting tensile-compressive yield point relationships shown in Fig. 3. To the left, in dashed lines, is shown the percent change in yield strength of 17ST extruded rod against percent pre-stretch (in terms of permanent set) when the stretching operation was performed several days after heat treatment. The Alcoa authors found, on this 17ST rod, that a 4 percent decrease occurred in the compressive yield stress at approximately 1½ percent pre-stretch, while the tensile yield point increased approximately 25 percent. The compressive yield point loss was overcome at 2½ percent pre-stretch, with the tensile yield point now increased 35 percent. According to these early investigations, aging time had a pronounced effect on resultant stresses; that is, pre-stretching within one hour after heat treatment gave considerably lower properties than when heat treatment was performed after several days' aging.

The right-hand set of curves of Fig. 3 (from the Templin and Sturm research data on 24ST tubing characteristics) indicate a similar effect of pre-stretch on 24S material—shown by the increase of the tensile point and the temporary dip in the compressive yield point.

(*Turn to page* 297)

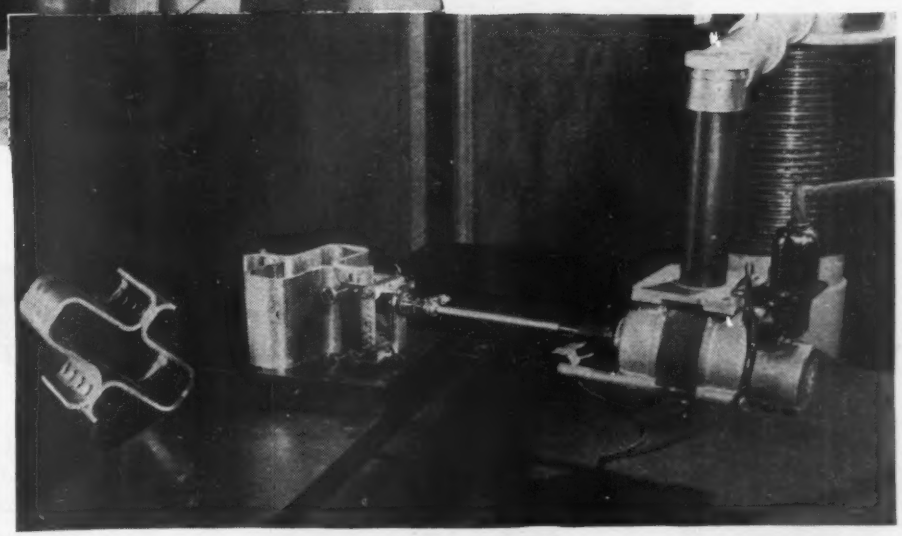


Fig. 10

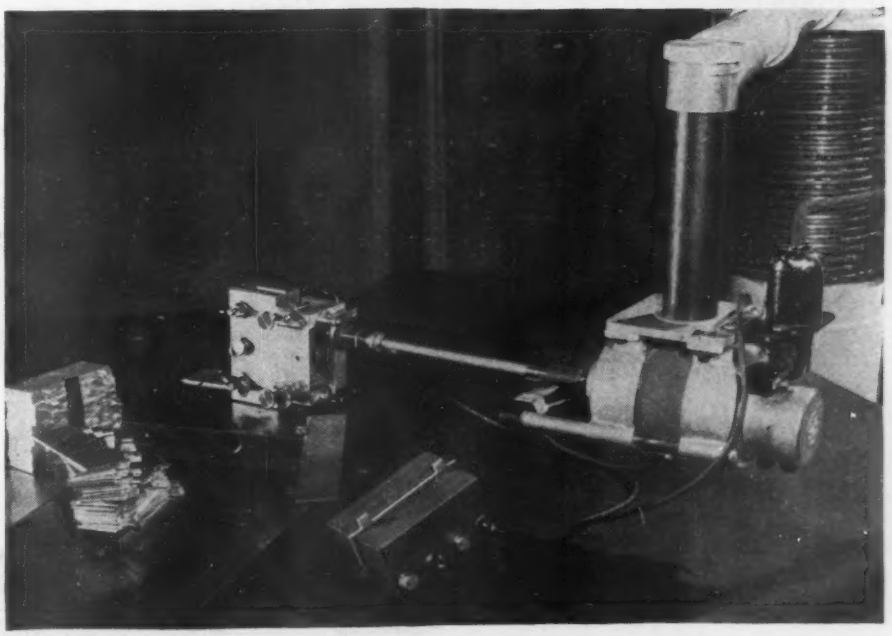


Fig. 11

"We feed these babies with a measuring spoon!"

THE modern aircraft engine has the power to move a freight train. Yet it weighs less than a pair of ordinary car wheels. The secret of its tremendous output without the need for massive parts lies in large measure in microscopic balance, high speed, and high efficiency, together with the miracle of modern alloys. Its power is smooth and tremendous when under instrument control . . . but is gone in a flash—along with a plane and a pilot, perhaps—if it is ineptly handled. Kollsman engine instruments—tachometers, manifold pressure gages, thermometers—are what give the pilot control over the torrent of power which propels him through the skies. Upon their precision and reliability has been built not a little of aviation's current advancement. Their role in tomorrow's progress is an even greater one.

THE KOLLSMAN ELECTRIC DUAL TACHOMETER AND SYNCHROSCOPE *not only registers engine revolutions in twin-engined planes, but directly compares the speed of the engines to permit perfect synchronization. It is electrically operated, with generators on the engines sending power impulses by wire to the indicators on the instrument panel.*

WHAT TOMORROW'S AIRCRAFT ENGINES *will look like or how they will perform, we don't know yet. But we do know that instruments will play a large part in expanding their scope and usefulness far beyond anything we know today. Kollsman engineers are constantly developing new and better aircraft instruments which will help widen and extend tomorrow's skyways for a new era in aviation.*

KOLLSMAN AIRCRAFT INSTRUMENTS

PRODUCT OF

SQUARE D COMPANY

ELMHURST, NEW YORK GLENDALE, CALIFORNIA

Cutting Costs on Perforating Dies

By E. H. RUDER

Production Tool Engineer, Missouri Plant, Curtiss-Wright Corp. Airplane Div.

Here is the step by step construction of a new type of inexpensive perforating die, which achieves high degree accuracy in simultaneous punching of multiple hole patterns in any combination.

ONE OF THE MAJOR PROBLEMS in mass production of aircraft is the drilling or punching of numerous rivet, bolt, and pilot holes in sheet metal stock. In fabricating the modern airplane it is not unusual to use several hundred thousand rivets, requiring over half a million rivet holes in the parts to be riveted.

Various processes have been tried to speed production of parts having rivet holes. The radial arm drill has been developed for drilling a stack of sheets from a sheet-metal drill template. While this method provides for drilling many sheets at one time, it is a relatively inaccurate and slow procedure. Moreover, stack drilling creates a very objectionable and extensive burring problem.

Yoke-type punch and die sets are frequently used to gang punch holes in parts. This process is limited to straight line punching at a relatively short distance from the edge of the stock. Gang punching of holes requires accurate individual set-up of each punch unit, and the distance between holes is limited by widths of the punch units. While gang punching may be advantageously employed in some instances, it is not suitable for punching holes in a vast majority of aircraft parts.

From the standpoint of increasing production, a steel perforating die affords an ideal solution to the problem of providing parts with rivet holes. Regardless of the pattern, spacing, and size of holes desired, a properly designed perforating die may be employed to punch simultaneously all of the holes in a part. Objection to this method is the cost of skilled labor and materials required to make such dies, especially the larger sizes that would be required for many aircraft parts.

Realizing the importance of increasing the rate of airplane production, the tool research and development department, at the Missouri plant of Curtiss-Wright has, after considerable experi-

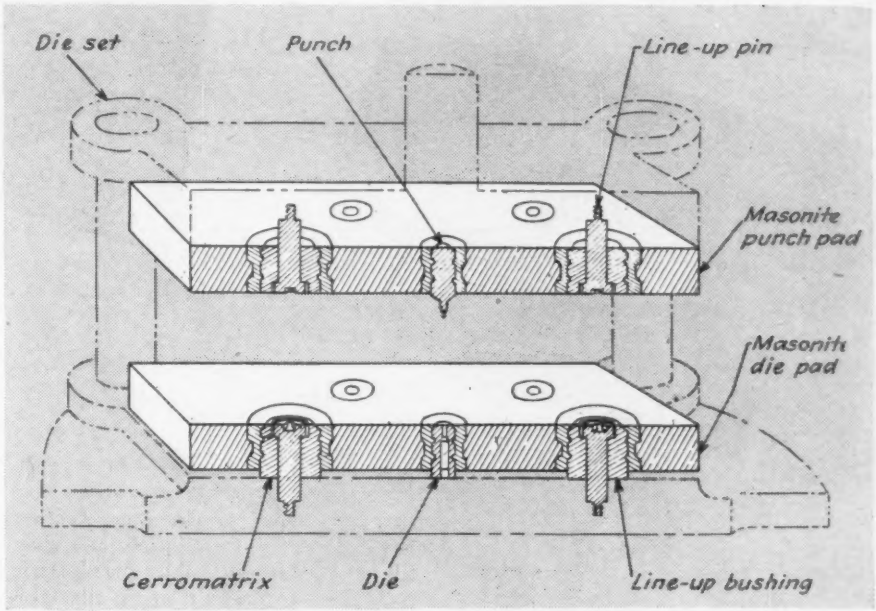


Fig. 1. Vertical section through a die assembly, showing Masonite perforating die attached to a sub-press.

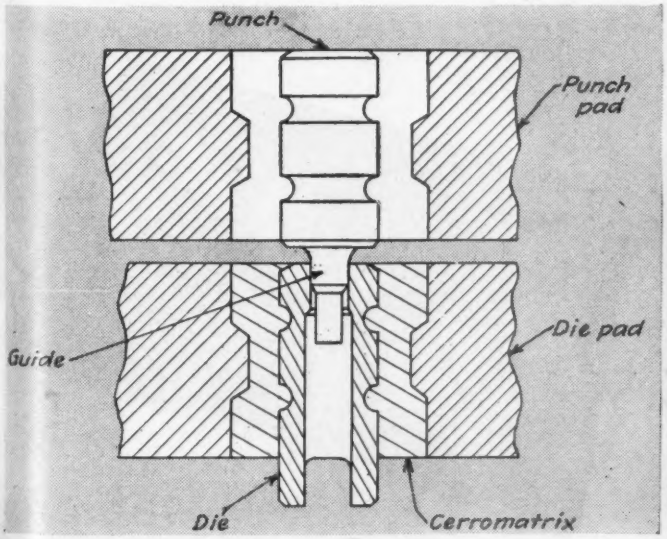
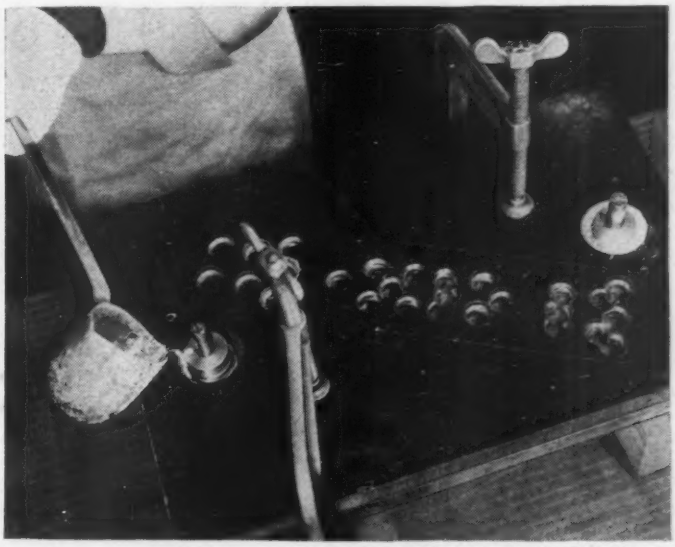


Fig. 2. Detailed vertical section through die pads, illustrating method of aligning punches with dies.



All Photos by Curtiss-Wright Corp.

Fig. 3. First step in assembling the die. Line-up bushings are secured in Masonite pads by Cerromatrix.

Fig. 4. Second step in assembling die. Template is provided with guide pins and is positioned on master plate. Several guide pins are shown on lower right corner of die pad.

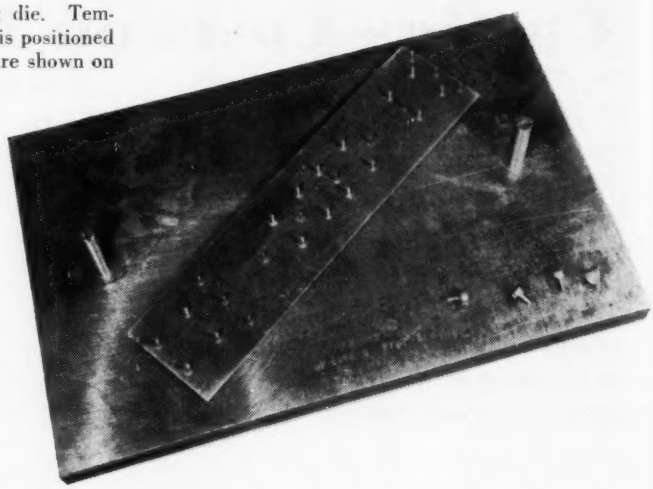
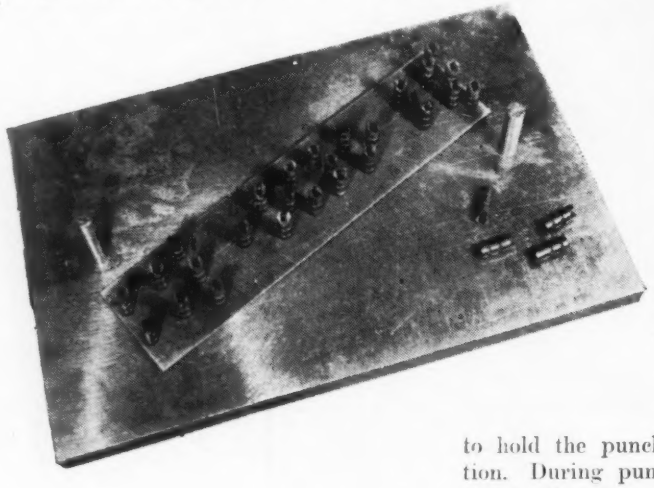


Fig. 5. Dies for punches are located on guide pins.



mentation, developed a low cost perforating die which may be economically employed to punch rapidly all holes in sheet metal parts. These dies may be made largely from nonessential materials while utilizing semi-skilled labor, thereby conserving critical material and skilled labor for other important tooling operations.

Construction of the newly developed punch and die assembly is illustrated in Fig. 1. The steel line-up bushings, punches, and dies are secured in Masonite die stock by means of Cerromatrix, an alloy having a low melting point of about 248 deg. and a slight expansion upon solidification. In production tests the Masonite was found adequate to hold the punches and dies in position. During punching operations, the metal die shoes receive the vertical thrusts imparted to punches and dies, while the Masonite and Cerromatrix merely serve to prevent lateral displacement of them. The use of Masonite punch and die pads has greatly simplified construction of the die, and the die pads may be readily drilled to provide openings for the line-up bushings, punches, and dies. These openings are considerably oversize, as shown in Fig. 1 and 2, thereby eliminating the necessity for a high degree of accuracy in drilling the openings.

Figs. 3 to 8 offer illustrations of various steps employed in making the dies. As an initial step, line-up bushings are secured within the Masonite pads. A master plate, having upwardly extended guide rods (Fig. 3) is employed to locate accurately bushings in the pads. Cerromatrix is then poured into openings around the bushings to anchor bushings in the pads. Guide rods on the master plate are positioned in accordance with line-up pin openings in the die shoes of the particular die set in which Masonite pads are to be installed.

To obtain standardization, die sets or sub-presses are made in various sizes to provide a range from the smallest to the largest size pads that may be used. A template is made for each size of die sets. This template is employed in drilling openings in the die shoes for line-up pins and also for locating guide rods in the master plate used in assembling the die. This procedure eliminates making separate die sets for each die.

After the pads are provided with line-up bushings, dies are secured to the die pad. A very simple procedure has been developed for accurately positioning dies in the pad. Guide pins are inserted in a template which is posi-

Fig. 6. Masonite die pad has been positioned over template, and Cerromatrix is being poured into openings around dies.

Fig. 7. Punches are inserted into die openings to provide exact alignment.

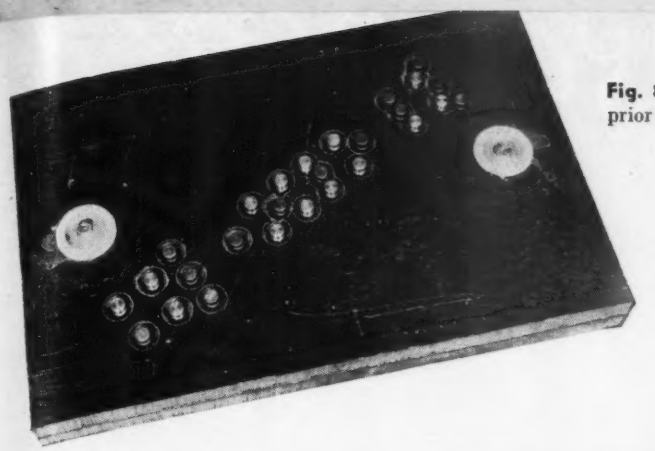
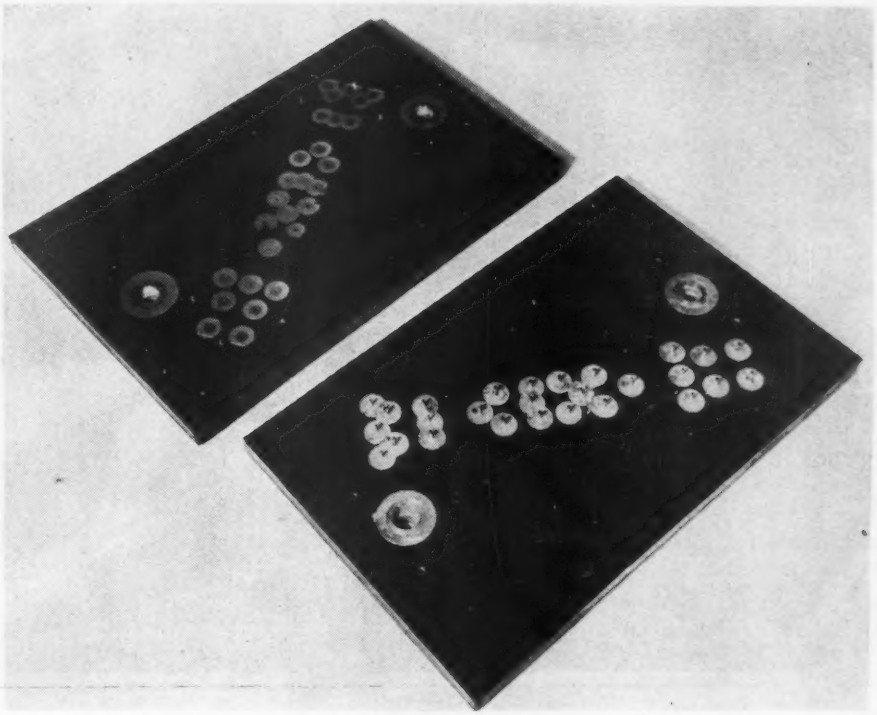


Fig. 8. Punch paid positioned on die pad prior to pouring Cerromatrix around punches.

Fig. 9. Finished die sections.



tioned on the master plate as shown in Fig. 4. The dies are inverted and placed on guide pins so that the dies will be held in alignment with openings in the template. Thereafter, the die pad is positioned over the template and Cerromatrix is poured into opening around the dies as shown in Fig. 6. To prevent the Cerromatrix from being splashed into die openings, clay or similar material is inserted into open ends of the dies. This clay may be readily removed after the Cerromatrix has solidified.

In the early stages of development it was found difficult to align accurately the punch tip in concentric relation to opening in the die. The punch tip was inserted in the die opening to hold the punch in position while the Cerromatrix was being poured into opening around the punch. Diameter of the die opening is larger than the diameter of punch tip to provide allowance for shearing clearance between punch and die. This difference in diameters permits undesirable shifting of the punch with respect to the die.

By a very simple arrangement this difficulty was overcome. The punch is provided with an enlarged guide portion between the punch tip and shank portion. When inserted into the die opening, as shown in Fig. 2, the guide positively locates punch tip in accurate alignment with die opening. This alignment is maintained while punch shank is secured to punch pad. To obtain best results, guide portion on the punch should have a diameter which will provide a relatively tight sliding fit in the die opening.

Upon inserting punches into die openings (Fig. 7) the Masonite punch pad is located on the die pad, as shown in Fig. 8, and Cerromatrix is poured into openings around the punches. In actual practice a sheet of paper is placed on the die pad prior to inserting punches into the dies. Punches may be easily forced through the paper which pre-

(*Turn to page* 314)

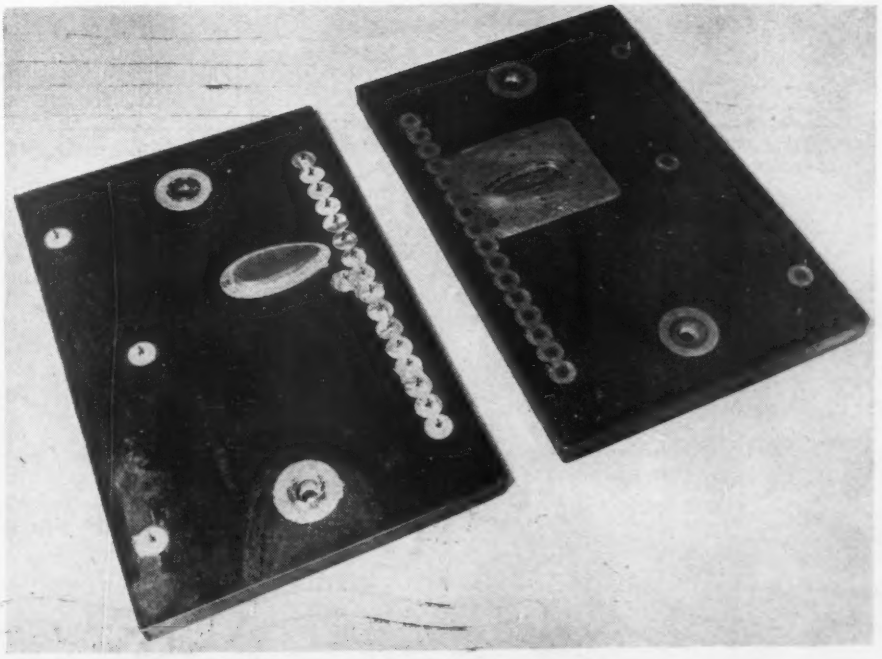
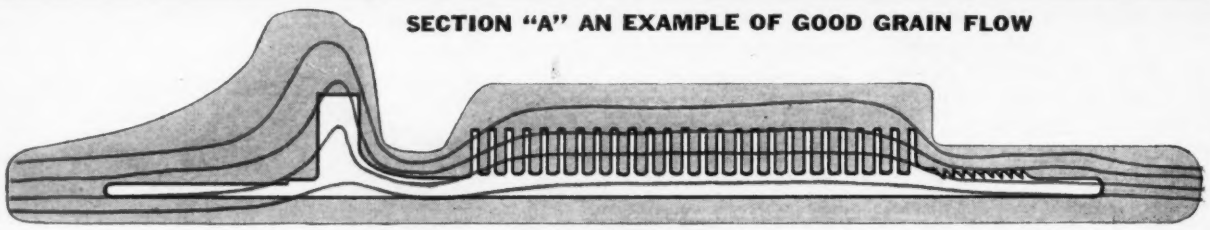


Fig. 10. An oval shaped punch and a Kirksite die secured in die pads.

How to get better

SECTION "A" AN EXAMPLE OF GOOD GRAIN FLOW

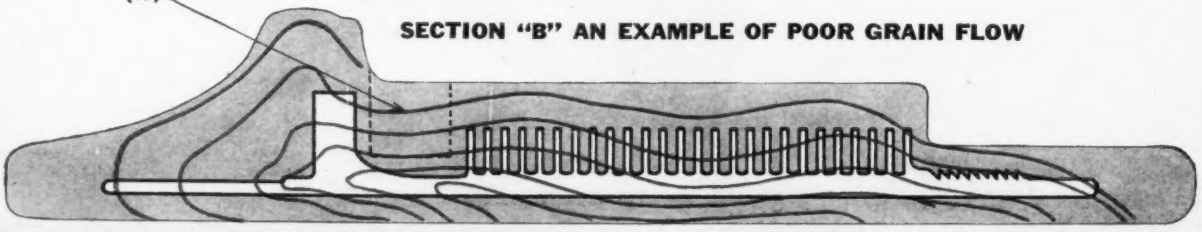


These diagramatic sketches of longitudinal cross sections of aircraft cylinder barrel forgings are based on actual metallurgical photographs showing grain fibre. Drawings were used to bring out more clearly *good and bad grain flow.* The red lines indicate the flow of the grain, or fibre, of the steel. The gray area shows the section from a rough forging. The white area visualizes the section from a finished barrel *(see photo at right, above)*, in relation to the forging sections.

Section "A" from a Tube Turns forging *(see photo at left, above)* has flow lines conforming more nearly to the outlines of the finished product. This forging will, therefore, have greater resistance to both static loading and repeated stress. Section "B" is from another type of cylinder forging with faulty grain flow. The only other difference between this section and Section "A" above is that the recess (indicated by dotted line area marked "X" is machined out later.

(X)

SECTION "B" AN EXAMPLE OF POOR GRAIN FLOW



cylinder and piston forgings

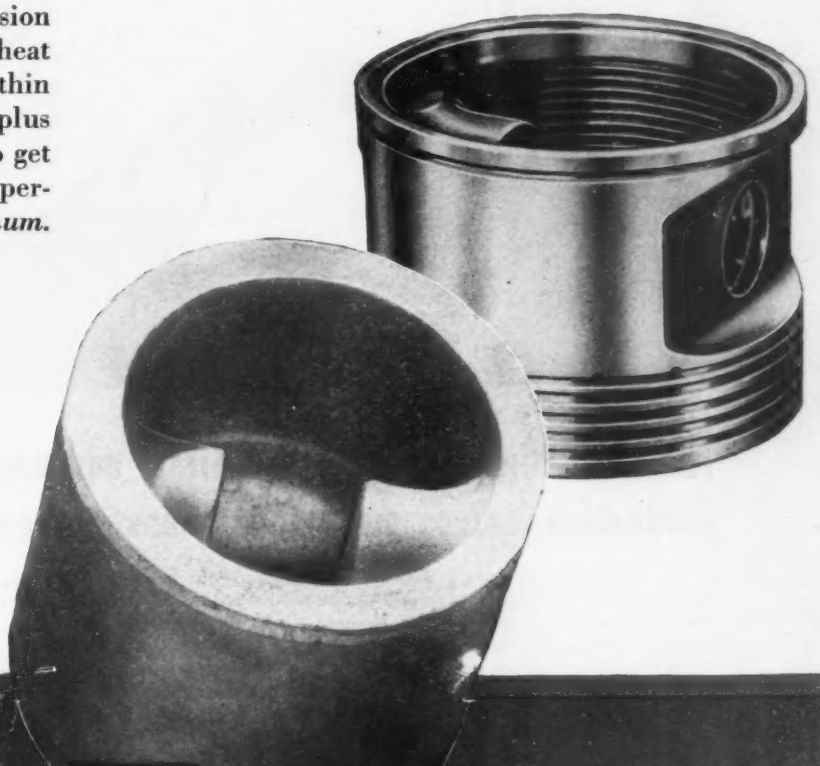
Tube Turns' accurate forging and heat treating methods on cylinder barrels and pistons help airplane engines perform better and last longer.

PICTURED at the left is a rough Tube Turns cylinder forging (one of several sizes forged by Tube Turns) and a finished barrel machined from this type of forging. Accurate forging plays a crucial part in the *quality and performance* of cylinder barrels. The forging operation affects both *grain flow* and *grain structure* of the steel. Its effect on flow of the grain is illustrated in the comparative drawings at the lower left. Correct grain flow increases the cylinder's resistance to static loading and to repeated stress.

In addition, Tube Turns maintains precision methods in all *heat treating* steps, so that heat treating and hardness are controlled within definite limits. Exacting control of heat, plus careful selection of materials, helps us to get *improved grain structure* and to hold permanent distortion to an *absolute minimum.*

These same factors—forging "know how" and careful heat treating—apply to Tube Turns' production of *aluminum piston forgings.* The most modern types of forging equipment enable us to combine *speed* with quality in forging both pistons and cylinders. This helps the engine manufacturers we serve to step up production of engines that are famous on every war front for extraordinary performance and endurance.

★ Tube Turns forges cylinder barrels in huge upsetters. Aluminum piston forgings (*shown at right, together with a finished piston*) are produced from one piece dies in Maxipresses. These latest types of forging machinery contribute greatly to the precision and speed that have made Tube Turns one of the outstanding forging organizations in the country.



ARMY (E) NAVY M

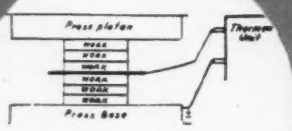
TUBE TURNS

Precision-Forged Cylinder Barrels and Aluminum Pistons

TUBE TURNS (Inc.) . . . . . LOUISVILLE, KENTUCKY

For over fifteen years, the Tube Turns organization has been recognized for its ability to originate and employ new forging methods that handle difficult operations with precision and speed that were impossible under older forging procedures.

YOU CAN DO PRACTICALLY EVERY TYPE OF WOOD AIRCRAFT BONDING WITH THERMEX!



Assemblies made SINGLY or IN MULTIPLES at one time!

MORE production with SAME jigs and fixtures!

CURVED sections bonded easily as FLAT pieces!

Thick spars or THIN panels bonded with SAME Thermex unit!

Thermex high frequency heating equipment speeds production, solves many tough construction problems!

In the construction of all wood aircraft, from gliders and basic trainers to huge "flying boxcars," Thermex high frequency heating equipment can handle practically every type of bonding.

Thermex heats *uniformly* and requires *only a fraction* of the time for bonding necessary with other methods. Thermex is equally effective for spars, skins, ribs, rudders and other sections and assemblies.

With Thermex *thick or thin* sections, *curved or flat* pieces can be bonded *singly or several at a time.*

With Thermex you can *improve quality,* get *more production* from existing jobs and fixtures.

Thermex equipment may be installed without disrupting your present production. Most models suitable for aircraft work are portable. Thermex equipment has great flexibility, being capable of handling a wide variety of jobs under different operating conditions. A number of presses can be operated consecutively from one Thermex machine.

Write today for illustrated Thermex booklet and special bulletins.

THERMEX EQUIPMENT IS DESIGNED FOR THE FREQUENCY BEST SUITED TO YOUR JOB

OTHER THERMEX ADVANTAGES

Uniform Heat—Heat generated in and thruout the product, assures even temperature rise.

Rapid Curing—Thermex heating sets the glue line in minutes instead of hours.

Saves Glue—Less glue is required with Thermex heating than when glue is cold set.

Minimum Tooling—Jigs and fixtures are not tied up for long periods.

Less Inventory—Use of Thermex saves inventory and floor space required for work in process.

Simple to Operate—Special training in electronics is not necessary. Thermex is as easy to operate as an ordinary radio set.

Many Sizes—Thermex is available in a wide range of standard sizes to meet many requirements.

The GIRDLER CORPORATION

Pioneers in Industrial High Frequency Heating

THERMEX DIVISION • LOUISVILLE, KENTUCKY

Ring Design Makes or Breaks the Engine

By D. M. SMITH and NELSON WAINWRIGHT
McQuay-Norris Mfg. Co.

Proper design in piston rings achieves full control over compression and oil consumption. Conversely, poor design cuts efficiency and ruins the engine. This discussion, based on test runs, points up definite conclusions which hold for low- and high-output engines alike.

A PISTON RING is a seal against the escape of compression from the combustion chamber and the escape of oil from the crankcase, and while other parts in the internal combustion engine are important and must correctly perform their individual jobs, the greatest burden of all falls upon the piston ring. When the engine performs satisfactorily, it is said to be a good engine. When the engine fails, it's a case of bad piston rings.

The bad piston rings—those of bad design—got that way because a correct analysis of the requirements was not properly made. Then there are cases where piston rings are supposed to do the impossible, where the piston itself is at fault, or where some other part is the contributing cause—where even the best of piston rings just can't make it.

Piston rings have always been a problem in automotive engines, industrial engines, and now in aircraft engines. The problem has always been the same: Control of compression and control of oil over a reasonable period of time. It is no different now, except in degree. The higher output engine, with its higher pressures and resultant higher temperatures, has required larger clearances. All this has increased the burden on the rings.

If it were not for the temperatures and pressures present, only small piston and ring clearances would be required—then the ring would fit more squarely against the cylinder wall and more uniformly in the groove.

Every engineer has dreamed of this ideal condition. It is unnecessary, though, to state that such a condition has still not been reached. We do have high temperatures in piston rings and cylinder walls, and clearances are necessary to keep these parts from seizing.

Clearance between piston and cylinder wall allows pistons to cock in the cylinder, first to one side and then to the other. Clearance between side of the ring and side of the groove allows the rings to cock, first to one side on the down stroke, then to the other side on the up stroke. The greater the clearance, the greater the cocking—and the more severe is wear on rings.

The best engine from a piston ring standpoint is a small bore, low horsepower, low temperature engine, and the least desirable is a high output, high temperature engine. Both extremes of engines, however, can be satisfactorily serviced by piston rings using the same principle in each case.

In examining piston rings after they have been run in an engine, unevenness of wear on their face surfaces will usually be evident. In some cases the top side of the ring face shows the greatest signs of wear, and in others the bottom side of the face has worn most. The same condition may be noted on side surfaces of piston rings, where sides of the rings have worn either at outer or inner edge. It is true that some of this condition of both face and side surface wear is due to inaccuracies in manufacture of the piston ring. It is also due, however, to the characteristic of the piston to flop from one side to another as it travels up and down in the cylinder, also to the existing pressures.

Much effort has been put upon the manufacture of piston rings to make them more perfect. Machinery and equipment has been designed to keep the sides parallel, to keep the sides at right angles to the face. Surfaces have been perfected, and sharp corners have been eliminated. But regardless of all this, it still takes only a single straw to cause a failure. The part is still too critical.

Compression should be controlled by

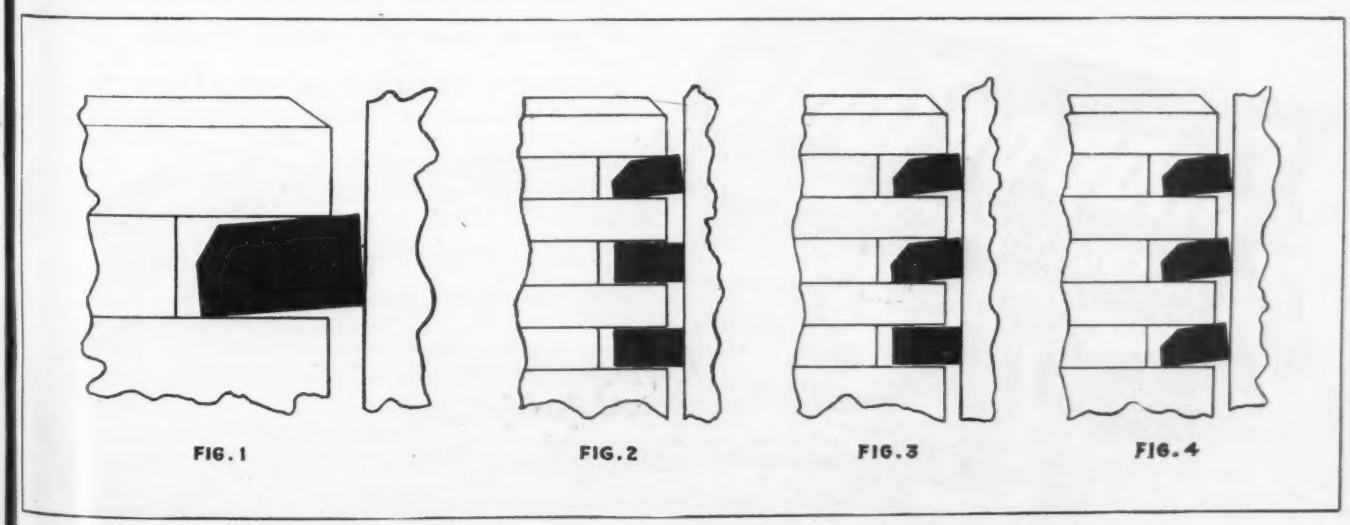


FIG. 1 FIG. 2 FIG. 3 FIG. 4

GOOD TOOLS ARE PART OF THE PICTURE

On Consolidated Vultee's vast mechanized assembly lines, where famed Liberator bombers and transports move swiftly to completion, Snap-on tools are part of the picture! Their accuracy, speed and power . . . their flexibility and ease of application in difficult places . . . save precious time in countless operations.

Everywhere in the great panorama of America's Production-for-Victory, Snap-on tools play a vital part . . . dependable aids to fast, accurate workmanship in every phase of production, assembly and maintenance. Write for catalog of 3,000 Snap-on tools, and address of nearest Snap-on factory branch.

SNAP-ON TOOLS CORPORATION
8020-H 28th Ave. • KENOSHA, WISCONSIN

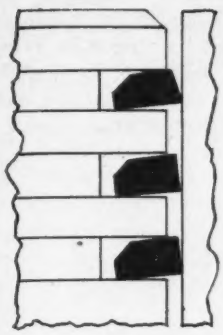


FIG. 5

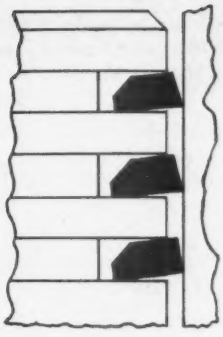


FIG. 6

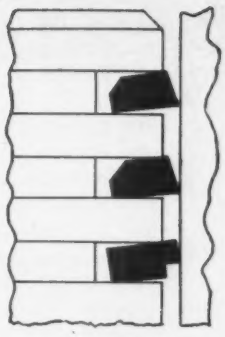


FIG. 7

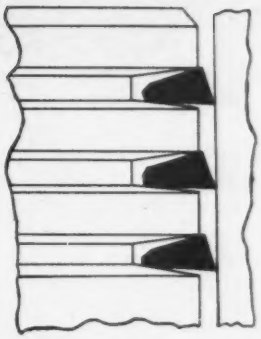


FIG. 8

compression rings. Oil should be controlled by oil rings. Oil sometimes is controlled by the loss of compression, which is not desirable. Obviously, rings closest to the combustion chamber should be the most effective in controlling compression, and rings closest to the crankcase should be the most effective in controlling the oil.

The first problem, then, is to hold compression in the combustion chamber as completely as possible, or prevent blowby, as it is most commonly referred to. Any loss of compression, or blowby, decreases efficiency of the engine, and increases fuel consumption and temperature of rings, piston, and cylinder wall. This in turn destroys partially, or entirely, the lubricating quality of the oil, allowing metal-to-metal contact, which is the start of scuffing, wear, scoring, lacquering, sticking, or seizure of these parts.

Blowby is a fooler. It can in small amounts also be the cause of low oil consumption; for obviously if blowby gases are moving toward the crankcase, oil will not at the same time be moving toward the combustion chamber. Where low oil consumption is accomplished through blowby, however, the life of the engine is generally very short. Performance falls off due either to abnormal wear or to scuffing, scoring, etc.

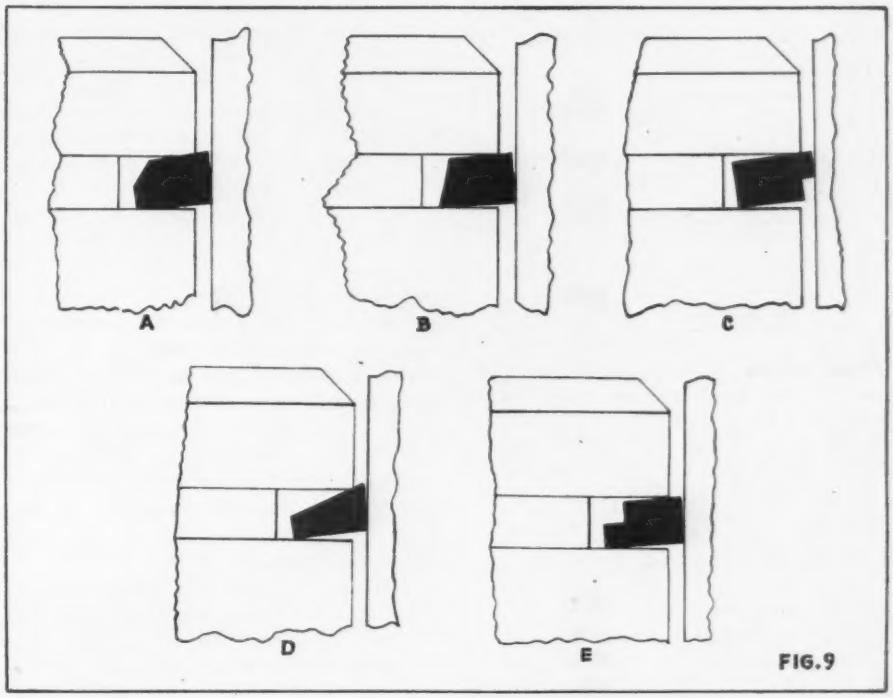
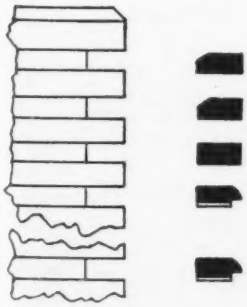


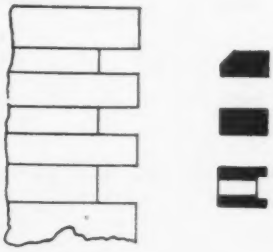
FIG. 9

The second problem is control of oil. The job here is to let just the necessary amount of oil reach the pistons and rings to lubricate them sufficiently. The use of oil is necessary to successful performance of an engine. The ideal situation is where the amount of oil consumed varies only slightly throughout the hours of engine operation. It is not desirable to have a high oil economy at the start with a quick drop-off, but rather uniform oil consumption throughout the life of the engine.

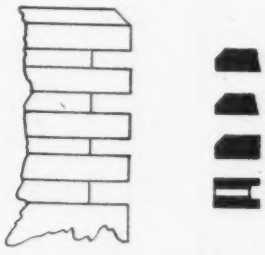
How is this all to be accomplished? It is a question of piston ring design



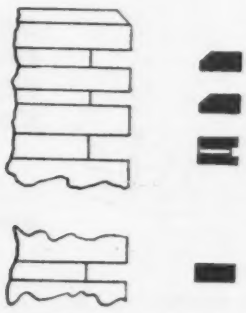
"A"-hp. engine, 150 hr. endurance test. Average rpm. 2,246. Average specific oil consumption .0024 lb. per bhp.-hr.



"B"-hp. engine tests, oil consumption reduced 75 percent. Blowby not in evidence.



"C"-hp. engine, 75 hr. continuous operation, 1,900 rpm. at open throttle. Average specific oil consumption .0027 lb. per bhp.-hr. Blowby not in evidence.



"D"-hp. engine, 150 hr. endurance test. Average rpm. 1,900. Average specific oil consumption .0041 lb. per bhp.-hr.

and, of course, the use of a suitable material and coating to meet the conditions of operation. Control of compression and control of oil must be considered as two separate and independent problems.

Control of compression is accomplished by use of an unbalanced ring section, where the ring, when closed, actually twists in the groove so that its lower-face corner bears heavily against the cylinder wall, the outer corner of its top side bears heavily against the top side of the groove, and the inner corner of its bottom side bears heavily against the bottom side of the groove (see Fig. 1). The rings must remain in this position throughout their operating life, for in this position the compression ring will give the maximum seal for control of compression or blowby.

In cases of low output engines, one such compression ring is sufficient in the top groove. In cases of higher output engines, three or more such rings may be necessary. This all depends upon output and design of the engine and also just how much burden is placed upon the piston rings. It can best be determined in each engine by actual tests. Combinations may be varied, depending upon conditions and how much compression control is needed.

In Figs. 2, 3, and 4 are three different combinations where, in the least critical case, only one beveled back torsional ring is used in the top groove. The other compression rings are conventional. In the most critical case, three beveled back torsional compression rings are used.

Note that the torsional or twisted rings in each instance contact cylinder wall and groove in the same manner as previously described.

Figs. 5, 6, and 7 show a tapered face ring in combination with a beveled back. A tapered face on a piston ring gives a high unit loaded scraping edge. If it were not for the fact that any removal of material or unbalancing of the ring section at the upper corner of the face of the ring twists it in the wrong direction, a tapered face ring would be effective. However, any results from a tapered face ring, except just this increased scraping edge, are caused through an increase in blowby. The tapered face is desirable in a choke bore to keep the top edge of the ring from contacting the cylinder wall and to maintain a high unit scraping edge —but in order to use the tapered face effectively, it must be combined with a beveled back, where there is sufficient removal of material from the upper inner corner of the ring to offset and reverse the effect of twist from tapering the face of the ring.

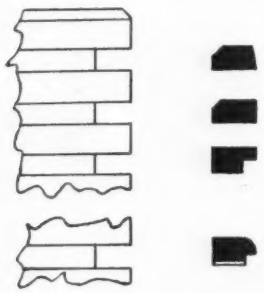
Fig. 8 shows a tapered face and tapered side in combination with a beveled back. Merely unbalancing the ring, as shown, has turned this ring into a seal against blowby, increasing life of the ring.

It will be noticed that the torsion or twist in all these rings is accomplished by a bevel on the upper inside corner, with exception of third ring shown in Fig. 7, where torsion or twist is accomplished by a groove in the lower outside corner.

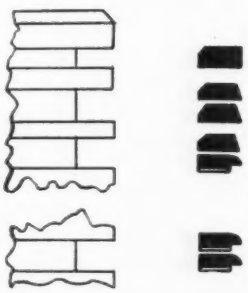
Removal of material to create the torsion can be in the form of a groove, a bevel, a taper, etc., as shown in Fig. 9. The proper torsion or twist will be accomplished just as long as the unbalancing is done at the upper inside corner or the lower outside corner. The amount of torsion is important, and in a majority of applications it is better to create the torsion by removing material from inner upper corner of the ring, rather than from lower corner of the face of the ring. In reality, the only time where it is important to remove material from the lower face corner of the ring is where additional unit load against the cylinder wall is required for oil control.

Thus, the torsional compression ring —contacting the cylinder wall with its lower edge, top side of the groove with its outer edge, and lower side of the groove with its inner edge and regardless of whether it is straight-faced or taper-faced, straight-sided or taper-

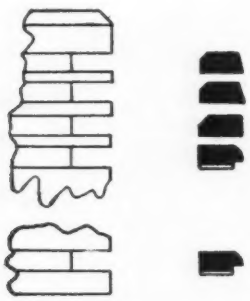
(*Turn to page* 326)



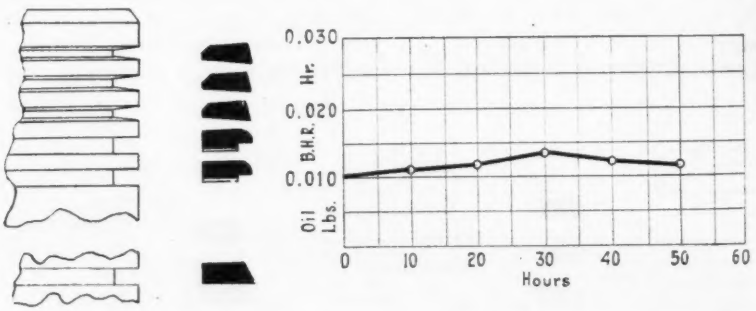
"E"-hp. engine, 50 hr. operation at 2,530 rpm. Average specific oil consumption .0029 lb. per bhp.-hr. Average blowby 1.5 cu. ft. per min. Fifteen hours at 2,980 rpm., average specific oil consumption .0046 lb. per bhp.-hr. Average blowby 2.2 cu. ft. per min.



"F"-hp. engine, 150 hr. model test. Average specific oil consumption .006 lb. per bhp.-hr. Average blowby 3.5 in H_2O negative.



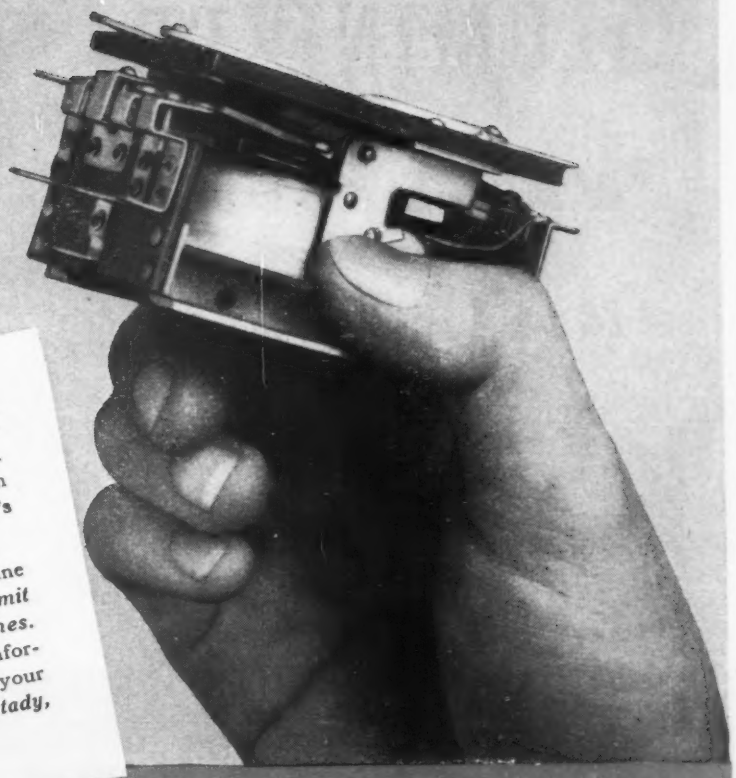
"H"-hp. engine, 100 hr. endurance test. Average specific oil consumption .0046 lb. per bhp.-hr. Average blowby 0. in H_2O in rear section. 300 hr. endurance test, average specific oil consumption .004 lb. per bhp.-hr. Average blowby .2 in H_2O in rear section.



Representative Cylinder Measurements Before and After Test (in inches)

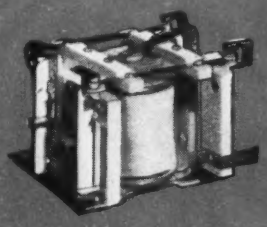
Cyl No.		With Valve Top	With Valve Bot.	90 deg Top	90 deg Bot
I	Before test	.0175 in.	.0175 in.	.0175 in.	.0175 in.
	After test	.017	.018	.018	.017
III	Before test	.0175	.0175	.0175	.0175
	After test	.0165	.018	.0165	.018
IV	Before test	.015	.0165	.015	.016
	After test	.0155	.0165	.0155	.016

LOOKING FOR AIRCRAFT RELAYS?



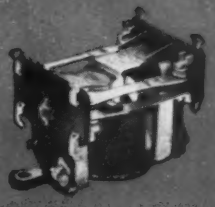
MORE than 25 different types of aircraft electric relays are now either in production or in final design at General Electric. Every one of these relays—a few are shown below—meet the U. S. Army Air Force's requirements for aircraft electric devices.

We now also have in production a full line of aircraft controls including *contactors, limit switches, solenoids,* and *pressure switches.* Our new catalog gives full descriptive information on all of these devices. Send for your copy today. *General Electric, Schenectady, New York.*



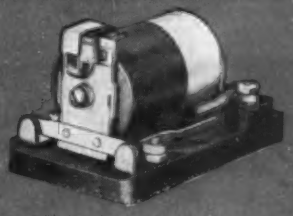
HIGH-VOLTAGE RELAY
CR2791-D100F
Contact Rating—0.020 amp, 1000 v, d-c

SENSITIVE RELAY
CR2791-C103C
Contact Rating—2 amp, 24 v, d-c

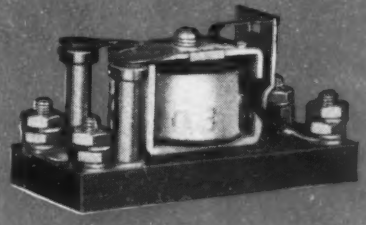


MULTIPOLE RELAY
CR2791-G100K
Contact Rating—10 amp, 12 or 24 v, d-c

DUST-TIGHT RELAY
CR2791-M100
Contact Rating—10 amp, 12 or 24 v, d-c



TIME-DELAY RELAY
CR2791-J102B
Contact Rating—20 amp, 12 or 24 v, d-c



25-AMPERE RELAY—TYPE B2A
CR2791-A100A
Contact Rating—25 amp, 12 or 24 v, d-c

GENERAL ELECTRIC

Send for **FREE CATALOG** on LIMIT SWITCHES, CONTACTORS, RELAYS, PRESSURE SWITCHES, and SOLENOIDS

General Electric, Section G676-86, Schenectady, N. Y.

Please send me your new catalog on aircraft control devices.

NAME.....

COMPANY.....

ADDRESS.....

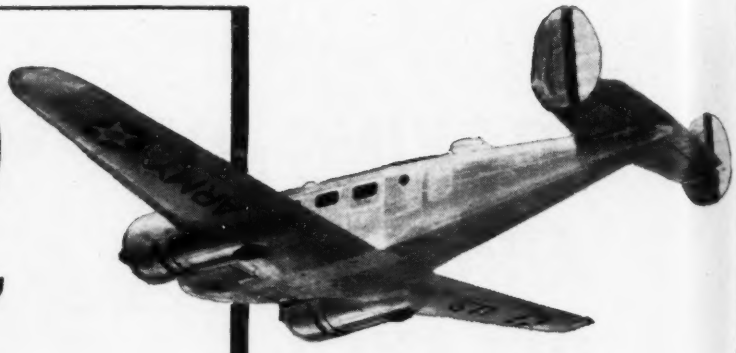
CITY..... STATE.....

676-86-3940

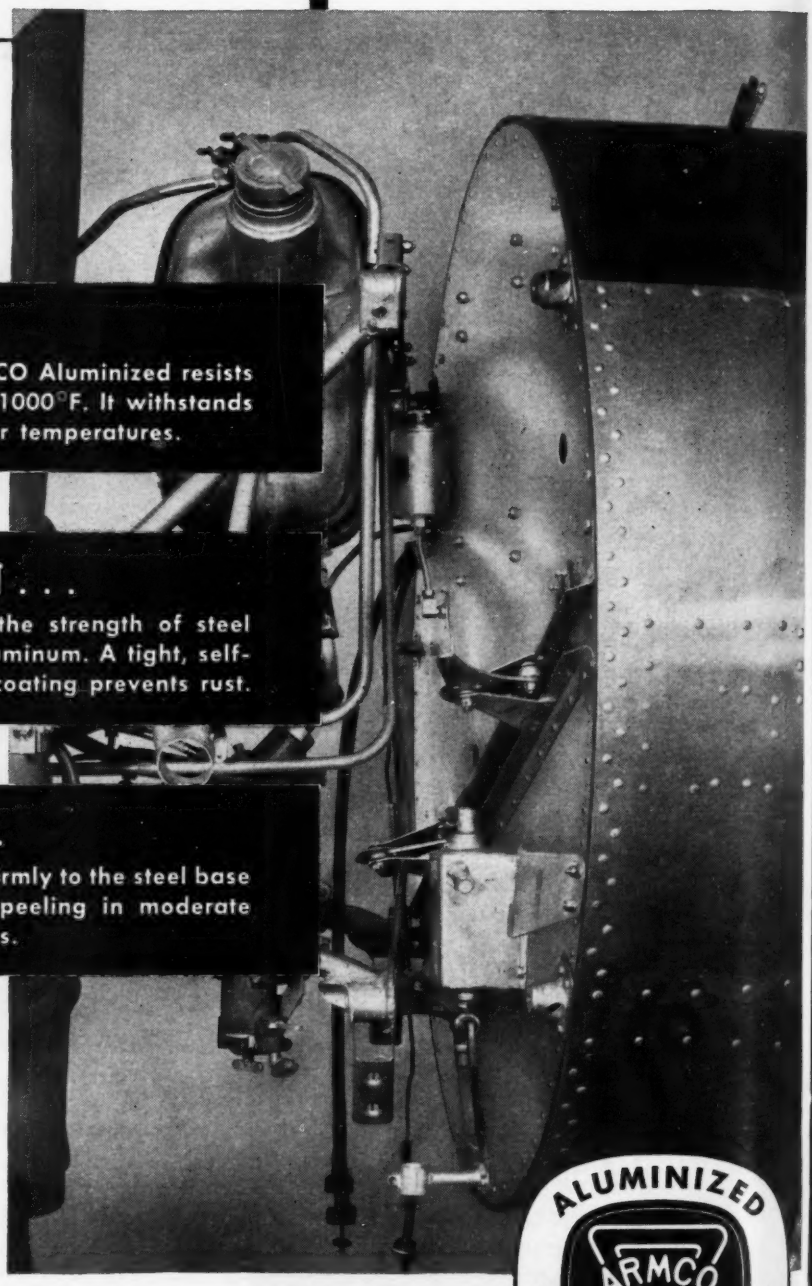
ALUMINIZED

"MAKES GOOD"

IN FIREWALLS



More and more of Uncle Sam's warplanes are now being equipped with firewalls made of ARMCO Aluminized Steel. This new ARMCO sheet metal is saving many tons of critical alloys for other essential uses. Check these "reasons why":



RESISTS HEAT . . .

The aluminum coating on ARMCO Aluminized resists heat discoloration up to about 1000°F. It withstands severe oxidation at even higher temperatures.

FIGHTS CORROSION . . .

ARMCO Aluminized combines the strength of steel with the surface qualities of aluminum. A tight, self-healing film on the aluminum coating prevents rust.

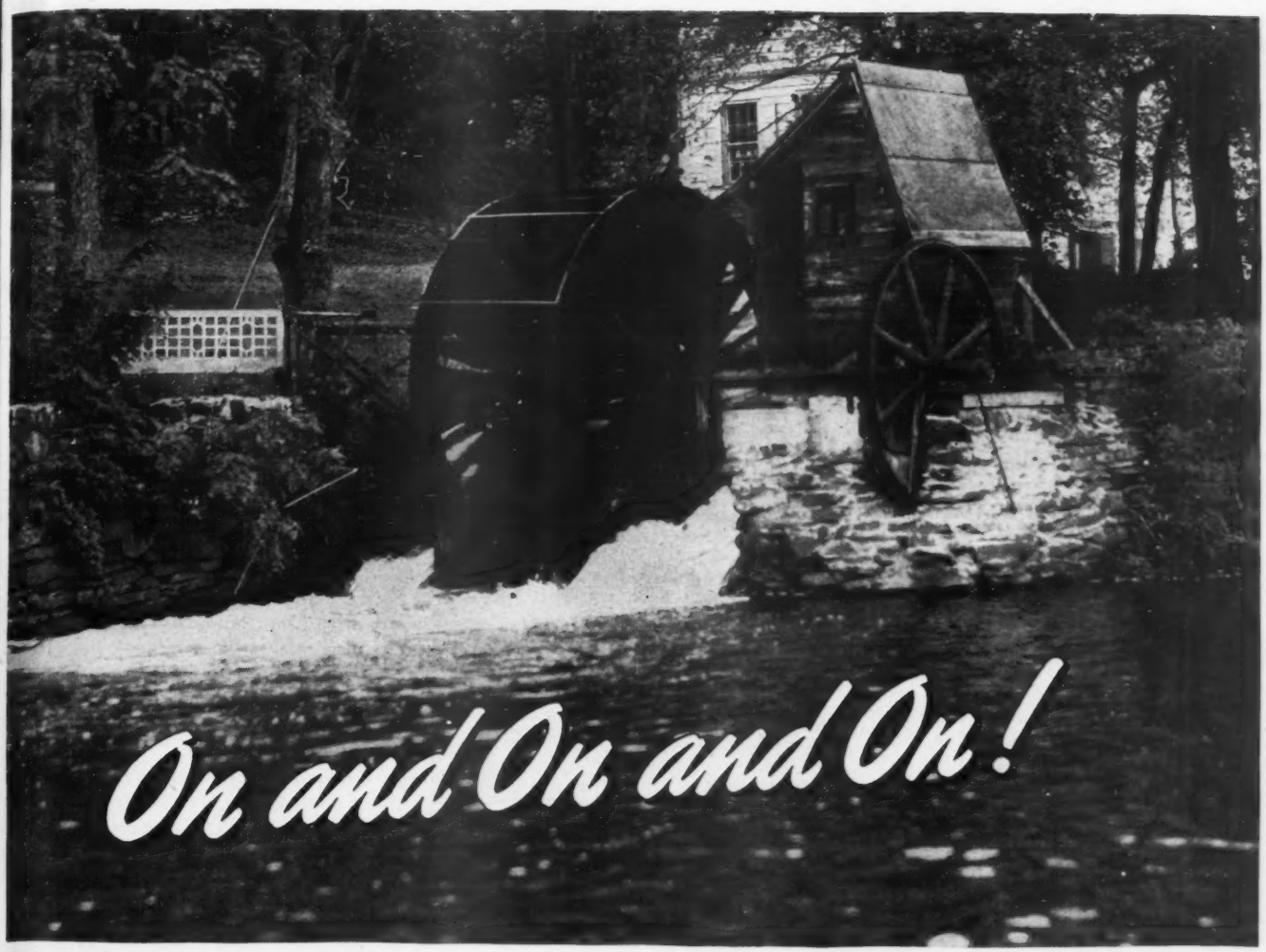
FORMS READILY . . .

The aluminum coating adheres firmly to the steel base metal. There is no flaking or peeling in moderate drawing and forming operations.

Could you use ARMCO Aluminized Steel in the firewalls of *your* warplanes? Approved by the Air Corps for this task, it is now undergoing tests for other parts. ARMCO Aluminized is supplied with a plain or copper-steel base, in sheets or coils. Gages are 16 to 28. After the war it will be supplied with a finish that can be buffed. For more data write to The American Rolling Mill Company, 2131 Curtis St., Middletown, O.

ALUMINIZED ★ ARMCO ★ STEEL

THE AMERICAN ROLLING MILL COMPANY



Long, uninterrupted service is called for in a capacitor and to fulfill that requirement three things are necessary:—intensive experience . . . advanced engineering . . . rigid production standards. This combination has given Tobe Capacitors a proud record, with almost complete absence of "returns."

The Tobe Oil-Mite Capacitor, shown

here, has consistently lived up to an established reputation for long life. This capacitor, impregnated and filled with mineral oil, is most carefully made and most conservatively rated. It is performing day-in, day-out duty as a filter condenser in war equipment. Inquiries in connection with your condenser problems will receive our prompt attention.

LONG LIFE ASSURED

CHARACTERISTICS OF TOBE OIL-MITE CAPACITORS

STANDARD CAPACITY TOLERANCE.	±10%
TEST VOLTAGE.....	Twice D.C. rating
SHUNT RESISTANCE	.05 to 0.1 mfd. 20,000 megohms. .25 to 0.5 mfd. 12,000 megohms. 1.0 to 2.0 mfd. 12,000 megohms
RATINGS.....	.05 mfd. to 2.0 mfd. 600 V.D.C. .05 mfd. to 1.0 mfd. 1,000 V.D.C.
GROUND TEST	2,500 Volts D.C.
POWER FACTOR.....	At 1,000 cycles—.002 to .005

TOBE DEUTSCHMANN CORP.
TOBE
CANTON · MASSACHUSETTS

A SMALL PART IN VICTORY TODAY
A BIG PART IN INDUSTRY TOMORROW

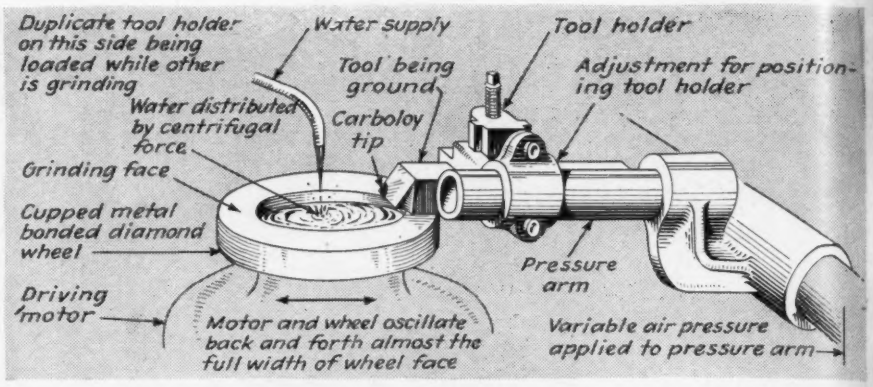
More Efficient Grinder For Carbide Tools

Developed by Carboloy and Edison Hotpoint, a new oscillating wet grinder has overcome the old difficulties of dry grinding carbide tipped tools. The silicon-carbide cupped wheels formerly used required almost as much time for dressing as was needed for grinding, and diamond wheels were too easily spoiled by grooving through improper handling, thus being impractical because of their great cost—$75 to $80 each.

The Carboloy grinder, however, can make good use of diamond wheels because the operator cannot damage them, and they require no dressing, which brings cost per tool down to a small figure. Grinding time has been reduced to less than 30 sec. per tool because the wheel is kept wet and the tool never becomes hot.

The cupped wheel is mounted horizontally in the center of the machine, carried on a reciprocating support which moves the cutting face toward and away from the tool as it grinds, giving a lapping action which keeps the wheel true and gives a fine finish to the tool. A stream of water into center of cup is spread outward to the grinding edge by centrifugal force. Two holding heads are provided so that one may be reloaded while the other is engaged in grinding, making the process six times faster than previous hand methods.

Pressure of tool on wheel is accomplished by automatic air pressure, which is not uniform but starts at low pressure to remove jagged edges first, then gradually increases to about 20 psi. between tool and wheel. It is automatic


Duplicate tool holder on this side being loaded while other is grinding
Water supply
Tool holder
Tool being ground
Adjustment for positioning tool holder
Water distributed by centrifugal force
Carboloy tip
Grinding face
Cupped metal bonded diamond wheel
Pressure arm
Driving motor
Motor and wheel oscillate back and forth almost the full width of wheel face
Variable air pressure applied to pressure arm

control which makes it impossible for an inexperienced operator to damage either tool or wheel. Peripheral speed of the wheel is kept at about 5,000 ft. per min. The holding arms are timed to the grinding operation so that the tool is lifted off the wheel at the end of a fixed cycle.

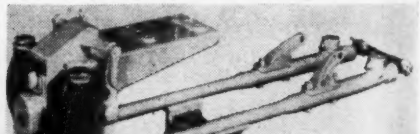
An additional advantage of automatic pressure control is that metal-bonded diamond impregnated wheels can be used instead of resinoid bonded wheels, thus giving vastly increased life to the most expensive unit.

Bell Machine Gun Adapter Raises the Score

Kept under cover by censorship until recently, the gun recoil damping device pictured here has been produced in large quantities by Bell Aircraft. It has been used as almost standard equipment on all types of bombers, both British and American.

Consisting of a lightweight cradle of two steel tubes incorporated with hydraulic absorption units, it attaches to the gun very quickly by means of two bolts, meanwhile adding less than an inch to over-all dimensions of the gun and only three pounds to the weight. It is now termed indispensable to accurate fire, and it saves much of the gun mount's structural weight which was formerly necessary to take recoil forces.

After the first of these .50-cal. adapters were put into successful operation, a .30-cal. mount followed in which the absorption unit consisted of air cushion, springs, and friction disks in place of hydraulic dampers. At present, twin gun mounts for both .30- and .50-cal. weapons are being built in addition to single gun units.



It is interesting to note that the present .50-cal. adapter goes back to experiments conducted with this machine gun on the Bell *Airacuda*. The first mount consisted of a steel tube frame connected to two automobile shock absorbers, which were attached to the gun. It worked so well that it served as a basis for the present design, which is very similar in principle.

(*Turn to page* 181)

Stalingrad Story

Your children's children will thrill to the story of Stalingrad.

—of the besieged, battered, hopeless city that was saved by white hooded infantrymen crawling on their bellies in swirling wastes of snow.

—saved by heroic ground forces whose magnificent air support never failed them.

Bell Airacobras, roaring over the Stalingrad front, gave wings to artillery. Above the masses of men and tanks locked in combat on the ground, they hunted out the enemy's vital spots—blasted them at short range with explosive and armor piercing cannon shells. Providing air support for ground troops is a job the Airacobra does superlatively well.

Here's the significant point. Airacobras were there in force when they were needed. We're able to deliver planes for action now *when they're needed* in this global war, because we started early enough, planned well enough and pushed production hard enough.

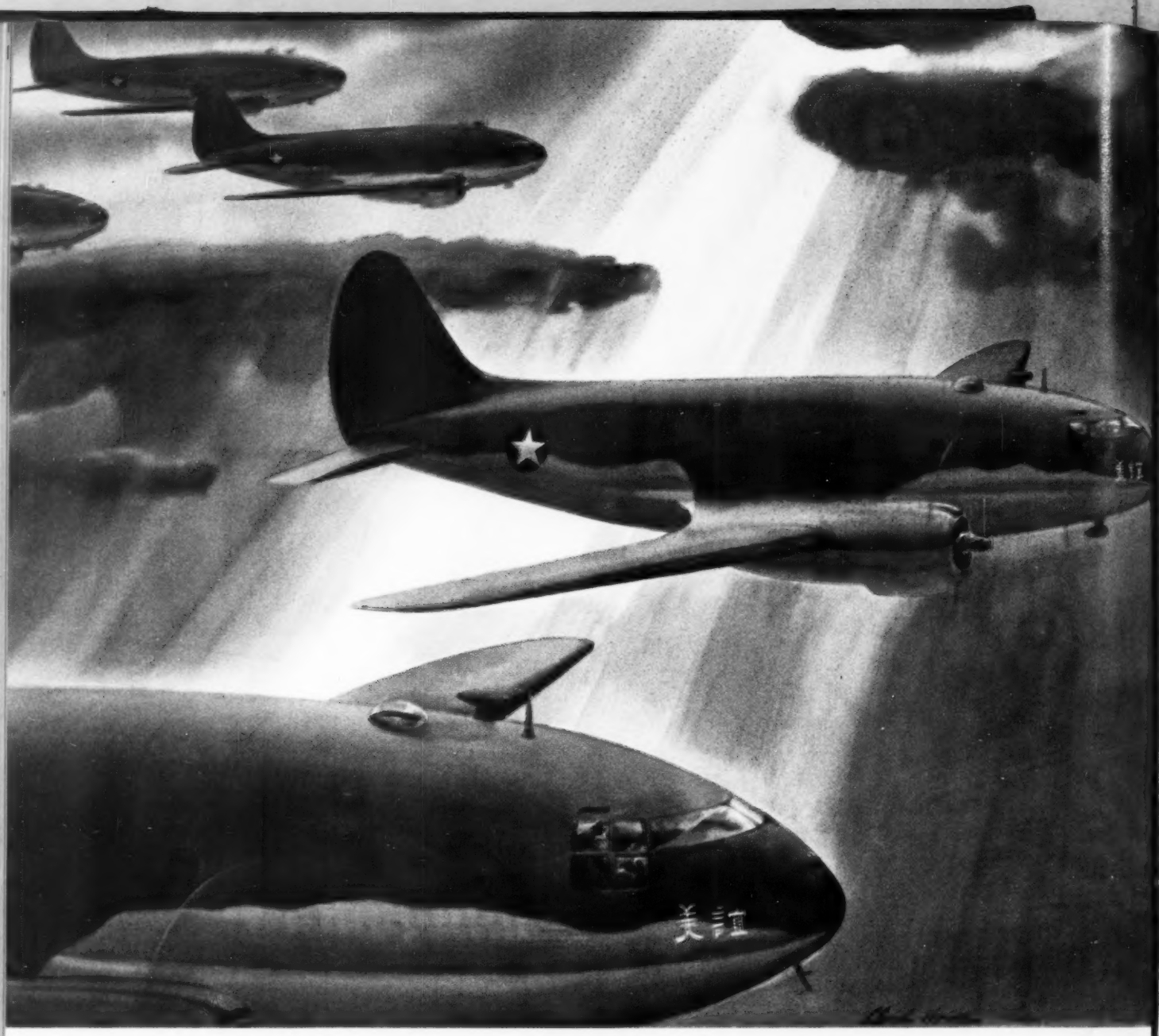
After victory we'll be telling you about new Bell planes, planes of peace. What will they be like? Well, they'll be designed, engineered and built by an organization that makes a habit of aviation pioneering. © Bell Aircraft Corporation, Buffalo and Niagara Falls, New York.

Airacobras for victory—

FUTURE PLANES FOR PEACE

BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS



HISTORY'S *Greatest* MASS FLIGHT

Not until the war is over and the need for secrecy is ended can the full importance of this achievement be realized. All that can be told today is that a large number of giant Curtiss Commando Transports in mass flight have spanned 15,000 miles of ocean and the land of three continents to complete the longest mass flight in history.

From an unrevealed starting point in the continental United States, they delivered without incident, *ninety tons* of cargo and a large group of military personnel in the time of *four and one half days.*

We salute the pilots, the crew and the ground organization of the Army Air Forces and Air Transport Command whose excellent performance made this flight possible. We, of Curtiss-Wright, know that this is but the beginning of a history making epic which will again prove the dependability, serviceability and cargo capacity of the Curtiss Commando.

CURTISS-WRIGHT
Corporation
AIRPLANE DIVISION

Member: Aircraft War Production Council, East Coast, Inc.

FIRST
Since the Birth of Aviation

CURTISS *Commandos*

FOR CARGO AND COMMERCE

The device is used on *Liberators*, *Fortresses*, *Mitchells*, *Marauders*, Navy dive bombers and torpedo planes, and Martin and Consolidated patrol bombers, as well as on British aircraft and on PT boats. The number required has necessitated formation of a separate ordnance division within the Bell company.

Wing Chord Divider Beam

A simple divider-beam device which saves nearly 75 percent of the time normally required by layout draftsmen for calculating and layout work is being used in the wing group of the Fleetwings engineering department.

In laying out wing contours for specified chord lengths, the first step is to divide the chord length into specified percentages of the chord. This involves a series of calculations of percentages times chord length before any ordinates can be drawn. To eliminate this slow process and the many attendant chances for mistakes, the divider beam was developed. It is made as follows:

Two bars of equal length are hinged together, providing the equivalent of an oversize chord line hinged at the 50 percent point. Each bar is perforated with a number of small holes at various intervals, each representing a certain chord percentage. The 0 and 100 percent marks at the bar ends are fixed at leading and trailing edge points by sharp-pointed steel pins. Intermediate points are marked by a third pin, which may be placed in the various holes, and these points are projected down to the chord line, dividing it into the desired percentages.

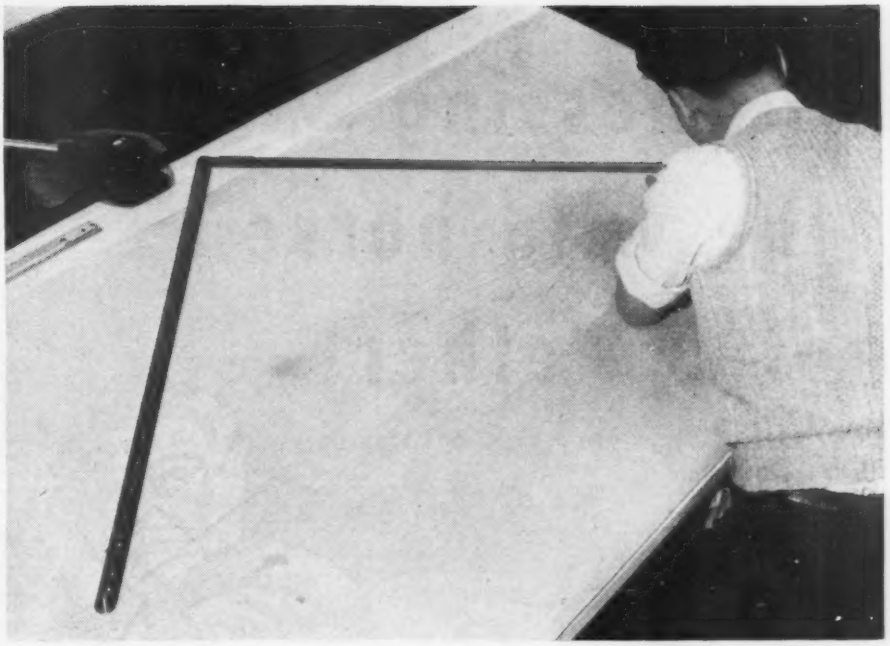
The savings in time can be readily appreciated, as well as the elimination of possibility for mistakes.

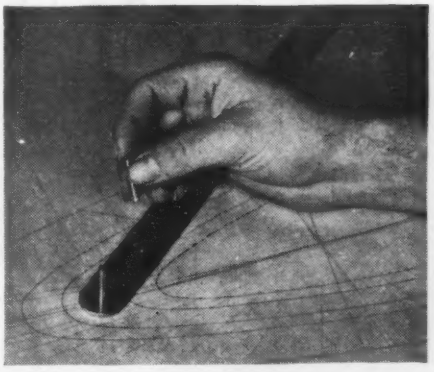
The two divider bars are of steel 1 in. wide and .095 in. thick, hinged by means of a flush rivet with the center drilled out to receive the small pin. Intermediate holes are of $\frac{3}{16}$ in. dia., and the pin, which is a close fit, has a fine point measuring .040 in. at the base. Accurately made and machine divided, this wing chord divider should save many man-hours for any engineering department.

Atomic-Hydrogen Welding Saves Aluminum Castings

Imperfect castings repaired by an atomic-hydrogen arc welding process have been found to pass rigid X-ray inspection with less than 1 percent rejection, saving untold time, labor, and material.

In the procedure, castings are first pre-heated in a furnace (seen in background behind welding unit in accompanying photo). Metal of the same analysis as the casting metal is then deposited by the atomic-hydrogen arc welding.

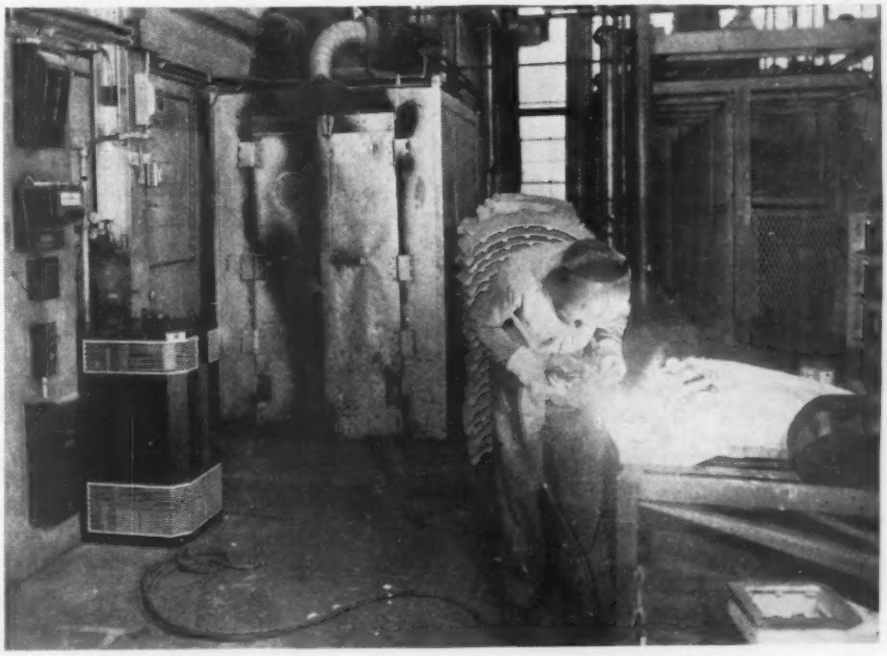




When welds are completed and ground flush with the surface, the outline cannot be detected either by X-ray inspection or physical testing. Experience has proved that without sacrifice in quality any casting can be salvaged no matter how large the imperfection.

The process was developed by General Electric, and the company which used the equipment illustrated recovered its investment in less than three months.

The same process is now in use to produce steel oxygen cylinders for the armed forces. Steel .043 in. sheet is rolled into tube form, with butting edges turned up in a slight burr. Edges are then automatically fused together without filler rod under the head of a 75 amp. atomic-hydrogen seam welder. Ends are welded in by the same means.



Harnessing "SPARK" the wild horse of the ether!

Every spark plug in an airplane engine (the Pratt & Whitney Twin Wasp shown here has 28!) emits a steady stream of genuine thunder and lightning—very welcome in the combustion chambers, but very detrimental to radio communication.

Harnessing these "wild horses of the ether" so that there will be a good hot spark in the cylinders and satisfactory reception in the radio system is the job being done by thousands of Bolton Shielded Ignition Harnesses now in combat service.

BOLTON *SHIELDED* IGNITION HARNESS

BOLTON MANUFACTURING CORPORATION

692 CAMPBELL AVENUE · WEST HAVEN · CONNECTICUT

TELEPHONE NEW HAVEN 9-4790

Sheet-Spring Fasteners Speed Aircraft Assembly

By HARM WHITE

Made from coiled strip stock in a wide variety of shapes and sizes, units save space, weight, and time on non-structural fabrication.

STEPS TO REDUCE space and weight in aircraft fastenings and to cut down the time required in their application has brought development of specialized spring-tension nuts. Moreover, a manufacturing technique is now featured which enables mass production of these units on high speed presses fed from coiled strip stock.

Consequently, shortages existing in the availability of approved nuts have now been relieved to a substantial degree where aircraft manufacturers have adopted these "sheet-spring" nuts on non-structural assemblies. For by so doing, the manufacturer releases other types of nuts for use on primary structures.

Basic in the idea, as developed in the Speed Nut system introduced by Tinnerman Products, was the combination of the nut and locking-element into one place. This was done by forming from suitable spring-steel a fastening that performed both functions and added new resilience to the sinews of aircraft.

Weight was reduced to a fraction of the conventional nut. Shorter bolts or screws are used, saving still more weight and space. Screws are also threaded faster into these spring-tension nuts, and being designed with integrally formed arched prongs to fit the helical curves of the threads, the nuts possess an inherent ability to resist vibration loosening. Indeed, upon application of increased strain tending to separate two assembled parts, the prongs of the nut press harder against the roots of the threads instead of loosening. The unit offers an inward thread lock on the screw as well as an arched spring-lock against the assembled part.

Weight savings, depending on the specific application, have been found to range from 50 to 80 percent. What may be regarded as equally important is the extreme rapidity with which the nuts can be applied to reduce aircraft assembly time. Here a saving from 50 to 75 percent of man-hours has been reported, with variance according to the particular application.

Nor did development of the system for aircraft stop with standard flat and round shapes. It went beyond that into self-retaining "U" nuts, "J" nuts, and speed clips, as well as innumerable designs to save still more weight by eliminating many other assembly parts.

Harness clamps have been developed that open and close as quickly as a safety pin. Made in circular shapes, they latch around bundles of wire in many sizes. One type was designed for intermediate locations, for example where groups of wires branch off from the main harness. Another type, featuring an integrally formed mounting means, was designed to serve as the main supporting clamp. In this way, all wire bundles could be held together during subassembly and while being transported to final location, thus eliminating taping or boggles.

Individual wires can now be replaced without even removing the supporting clamp, which opens without need for detachment from the structure. These harness clamps of spring steel are Parkerized and given two coats of gray lacquer. They are then covered with extruded synthetic rubber channels (of various types suitable to the application) for cushioning. They are made in ten different sizes for wire bundles from $\frac{1}{8}$ to $1\frac{1}{2}$ in. dia. In attaching these harness clamps to the structure, the standard flat type and self-retaining "U" type nuts are used.

A new line of angle brackets combined with fasteners has also recently been developed in various shapes and sizes to speed up all types of angular

Fig. 1. Worker snaps "U" nuts into place over screw holes. Since these units are self-retaining, assembly may then be completed without necessity of holding nuts.

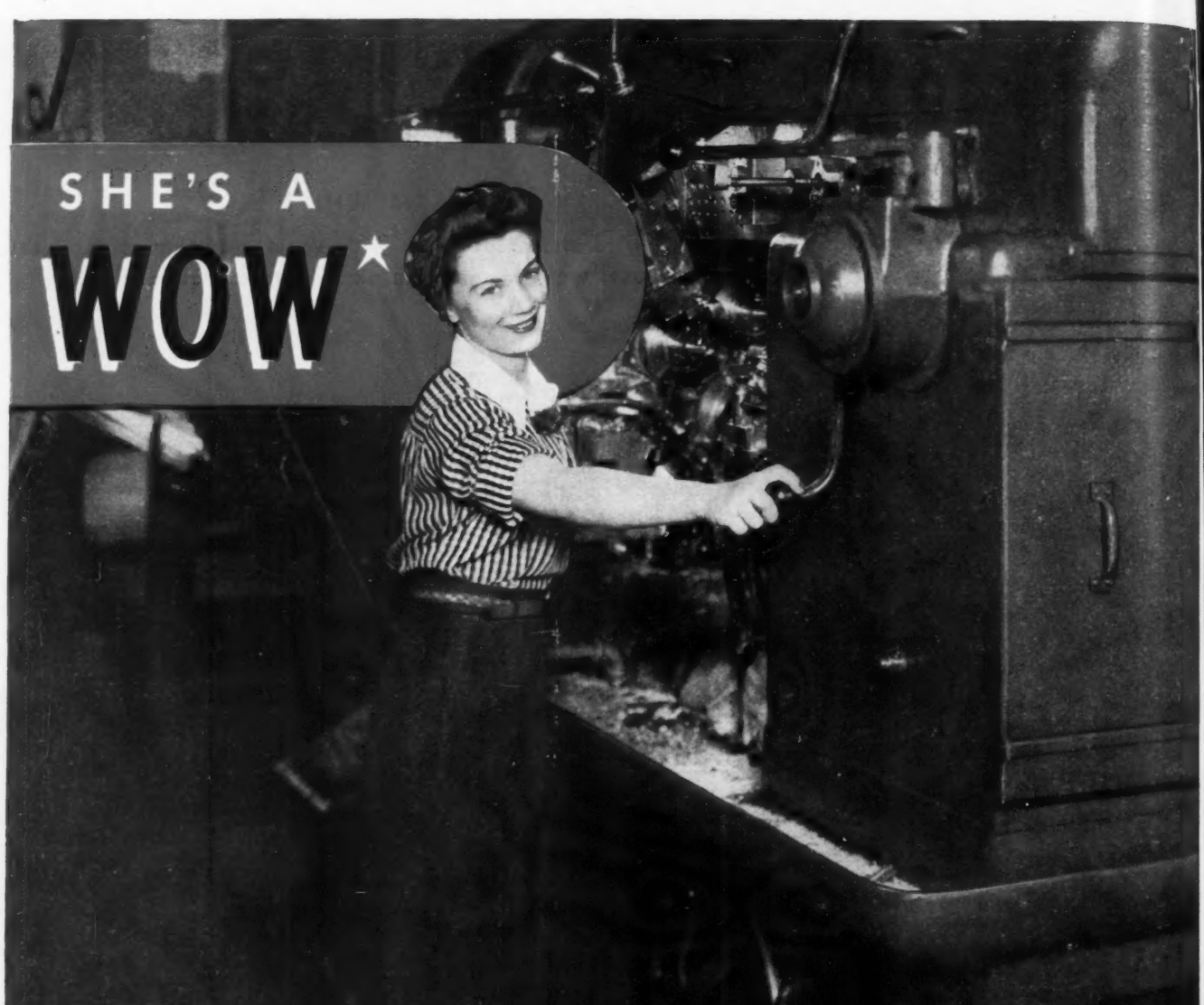


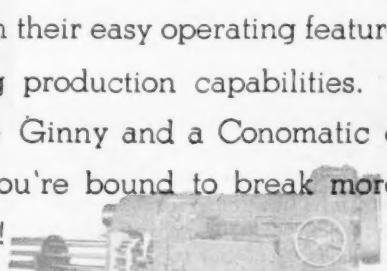
PHOTO COURTESY THE HOSDREG CO., INC., HUNTINGTON, INDIANA

SHE'S GINNY CLOSE—21 years old—95 pounds—married—member of the 10% Club—she's a WOW*. In fact she's the smallest multiple spindle automatic lathe operator in the world.

But she holds a more important record—2286 shells produced in 8 hours with the help of her 8-spindle Conomatic. She does her own tool setting, loads the machine with stock, beats the boys at their own game, then takes care of her six room house, and feeds 100 chickens and a farmer husband.

The Hosdreg Company is pretty proud of Ginny, with her cheerful attitude and happy smile—and also proud of their Conomatics, with their easy operating features and outstanding production capabilities. Get a WOW like Ginny and a Conomatic on the job, and you're bound to break more than one record!

*Woman Ordnance Worker



CONE Automatic Machine Company, Inc., Windsor, Vermont

attachments and reduce weight still more. All of them have one or two integrally formed Speed Nuts. Separate nuts are eliminated, parts are reduced, and weight is saved. Where riveting is necessary the nut is preformed in but one leg of the bracket, and holes are pre-punched in the other leg. For such applications, four holes are provided so that two rivets may be applied either vertically or horizontally, according to need. The nut is formed for 8Z and 10Z Air Corps sheet metal screws.

When used in connection with conduit and piping, this new bracket also permits the use of standard bonding clamps in place of ear-type aluminum bonding clamps. Consequently it saves aluminum and reduces the number of stock parts as well.

The fairlead guide block has been another knotty problem requiring drilling of angular holes to get proper cable alignment. To save drilling these holes one at a time during assembly, the company developed a fairlead guide block with a new type twin nut housing. A macerated phenolic plastic guide is locked between a metal bracket and an integrally formed Speed Nut. The plastic guide within the metal housing is adjustable to any angle of cable (by means of a screwdriver) and its eccentric center plug is rotatable for centering the cable. It accommodates cables up to $\frac{1}{8}$ in. dia.

Another feature of this new adjustable block is that the plastic parts may be easily replaced, if necessary, without unthreading the cable. There are two types. The standard No. 5921 requires a $\frac{7}{8}$ in. dia. hole in the bulkhead.

Where a $\frac{7}{32}$-in. dia. hole is practical, #5921-A is used. This fairlead is exactly like #5921 only the aluminum base is not used. The plastic guide is housed in a $\frac{7}{32}$ in. dia. hole in the structure and is held firmly in place with the top nut. With this new device, angular drilling is eliminated and fairlead holes can be pre-punched or predrilled.

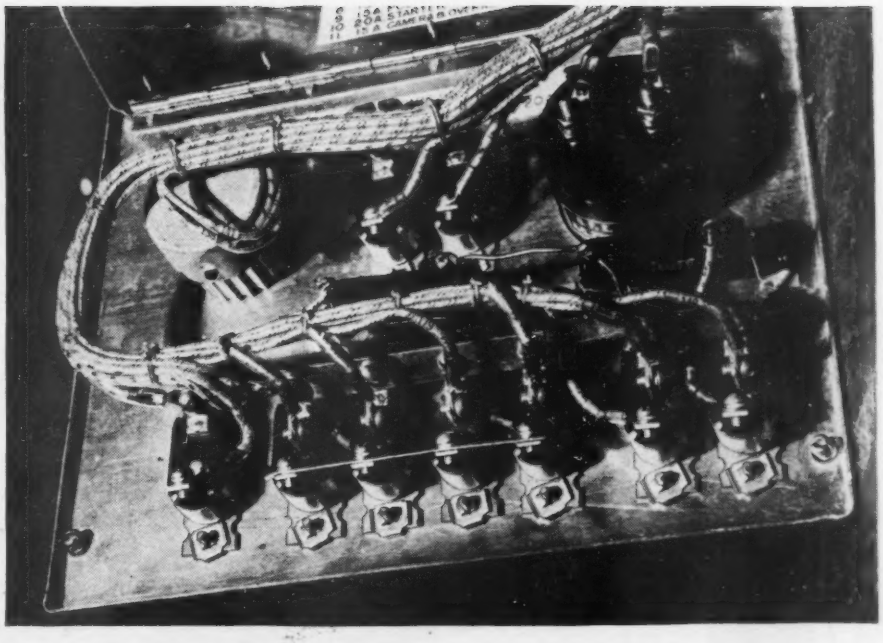


Fig. 2. How "J" type nuts are employed to fasten down switches in aircraft switch boxes. Former method called for brass nuts which had to be brazed into position.

Another saver of assembly time and weight recently developed is the "C"-shape nut for use on tube clamps. This light weight spring-steel, self-retaining nut snaps over either hole in a standard tube clamp. The assembler therefore need only hold the tubing and the clamp in one hand, hence he can complete the assembly with a conventional screwdriver.

Formerly, it was necessary to hold the tubing, clamp, screw, nut, and washer all by hand. Then, after getting all five parts properly lined up with the hole, the assembler still had to use both a screwdriver and a wrench. With so many inaccessible locations, the old method was not only slow, but the assemblers had a difficult task. Now, by reducing the number of parts through adopting self-retaining nuts, the grief is gone and hydraulic lines are being installed in less time.

In the assembly of the air scoop fairing on the Lockheed P-38 *Lightning*, "U" shaped nuts have been adopted to replace nut-plates which required two rivets each. Formerly each assembly had 72 nut-plates requiring 144 riveting operations. The new method saved these 144 riveting operations. These "U" nuts are instantly snapped into place over the screw holes, as shown in Fig. 1. They are self-retaining so that

(*Turn to page* 294)

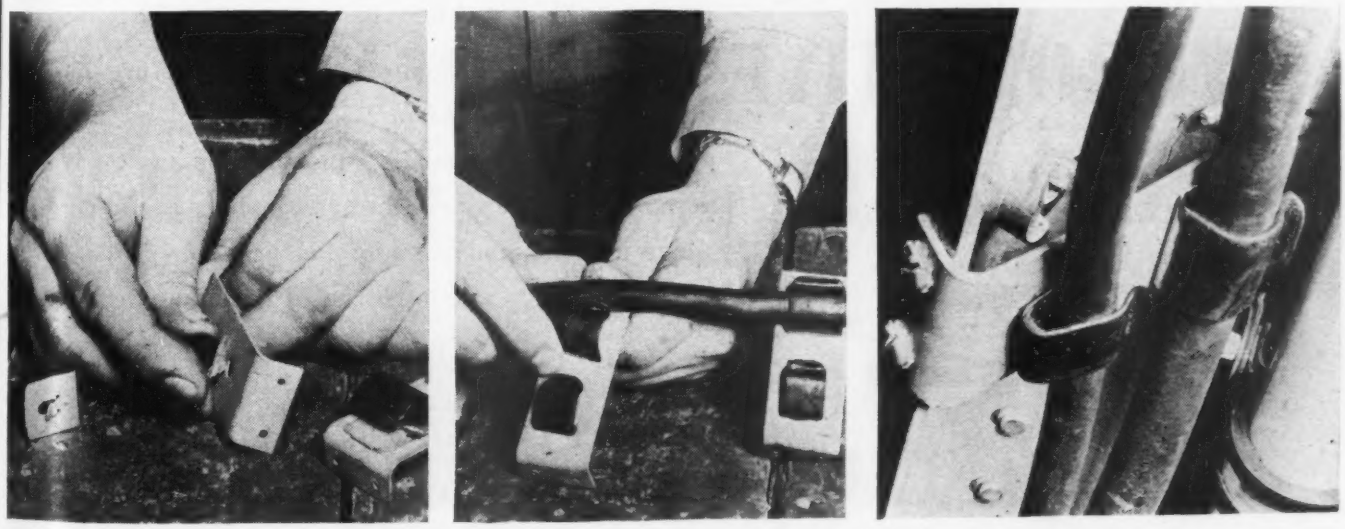
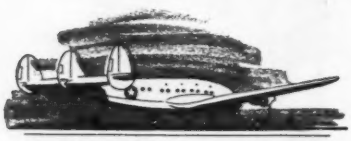


Fig. 3. Here, cable clip (which does not require bolts, screws, rivets, or use of tools) is seen in use. Left: Worker fits lip of clip into hole of structure. Catch locks clip into position. Center: Snapping cable into clip. Right: Completed assembly.

Lockheed CONSTELLATION

uses

VICKERS HYDROMOTIVE CONTROLS



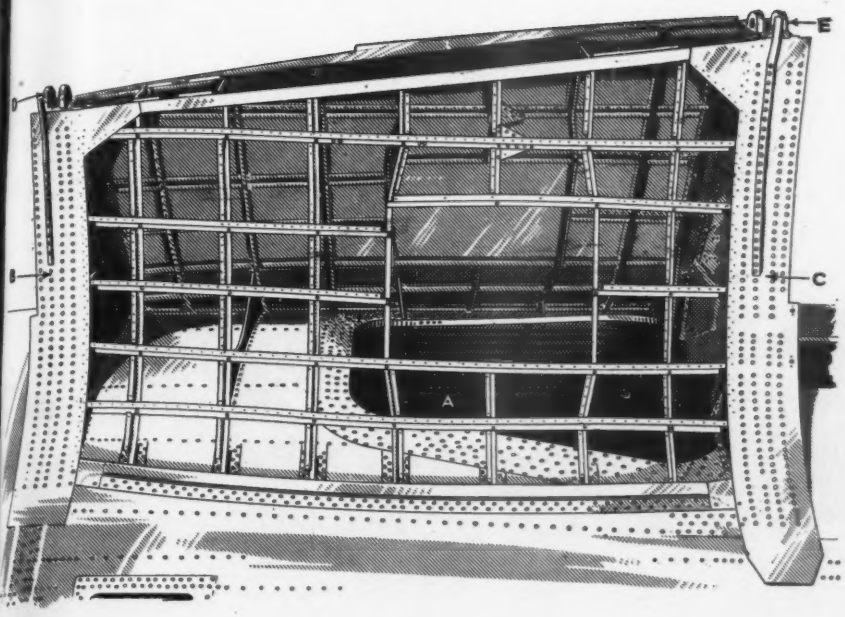
Vickers Hydraulic Equipment is used on many of the most modern airplanes. The Lockheed "Constellation" Transport illustrated here is representative.

Vickers Hydraulic Controls are high pressure oil hydraulic controls that are so widely used because they do the job dependably, smoothly and accurately ...no matter how severe the service. They are insensitive to shock and vibration yet light in weight... easy to adjust...admirably suited to aircraft needs.

VICKERS *Incorporated*

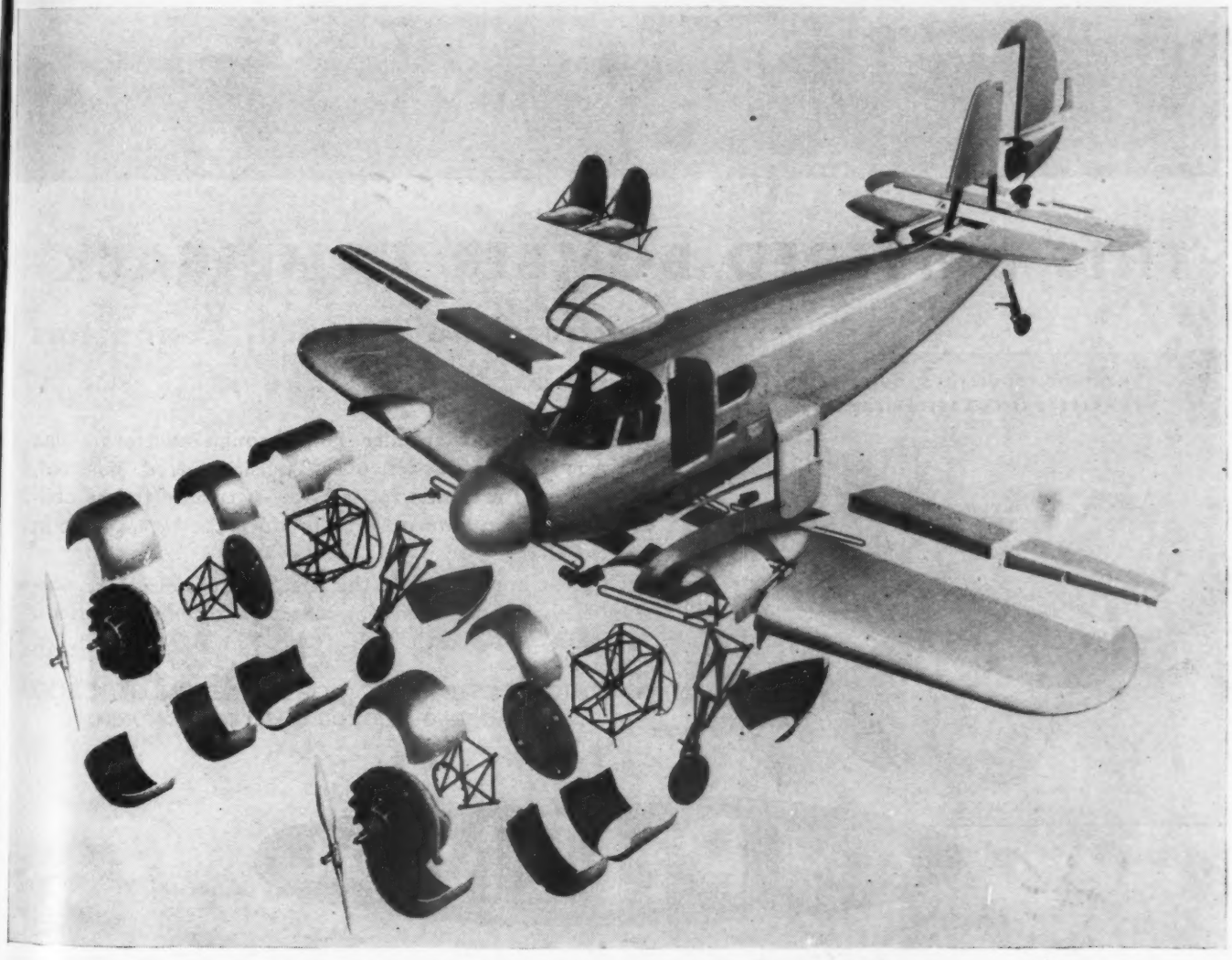
1462 OAKMAN BLVD. • DETROIT, MICH.

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921



SKETCH BOOK OF DESIGN DETAIL

Shown here is superstructure of Consolidated Vultee PBY *Catalina*, revealing mechanic's cockpit *A* at deckline, major components being solid, built-up bulkheads *B* and *C*. Wing attachment points *D* and *E* also play vital role during production, serving as holding points for locating bar to insure complete interchangeability between craft.



Exploded view showing subassemblies of the Cessna AT-17 *Bobcat*, used by Army Air Forces both as advanced trainer and personnel carrier. From an original by Wilmer Brice of Cessna engineering department.

Lockheed CONSTELLATION

uses

VICKERS HYDROMOTIVE CONTROLS

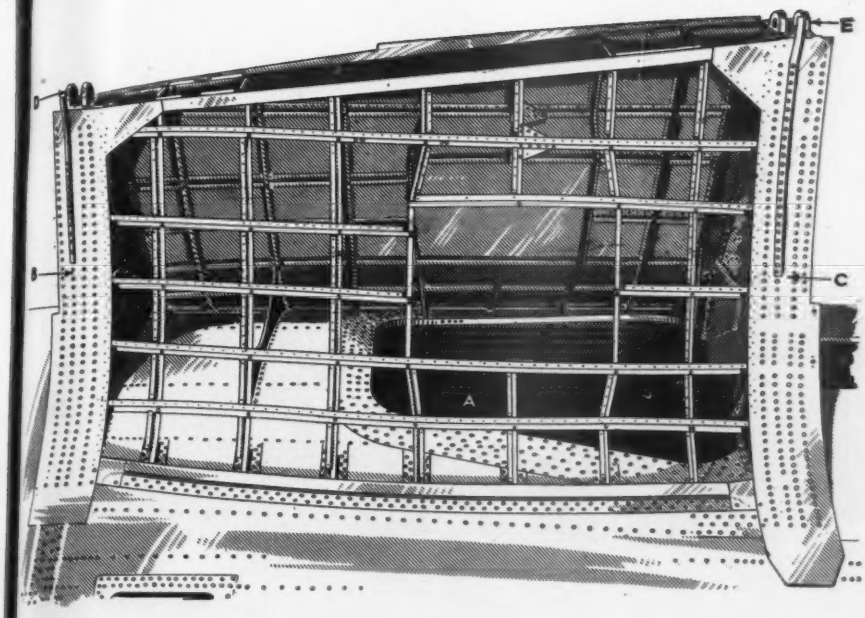
Vickers Hydraulic Equipment is used on many of the most modern airplanes. The Lockheed "Constellation" Transport illustrated here is representative.

Vickers Hydraulic Controls are high pressure oil hydraulic controls that are so widely used because they do the job dependably, smoothly and accurately ...no matter how severe the service. They are insensitive to shock and vibration yet light in weight... easy to adjust...admirably suited to aircraft needs.

VICKERS *Incorporated*

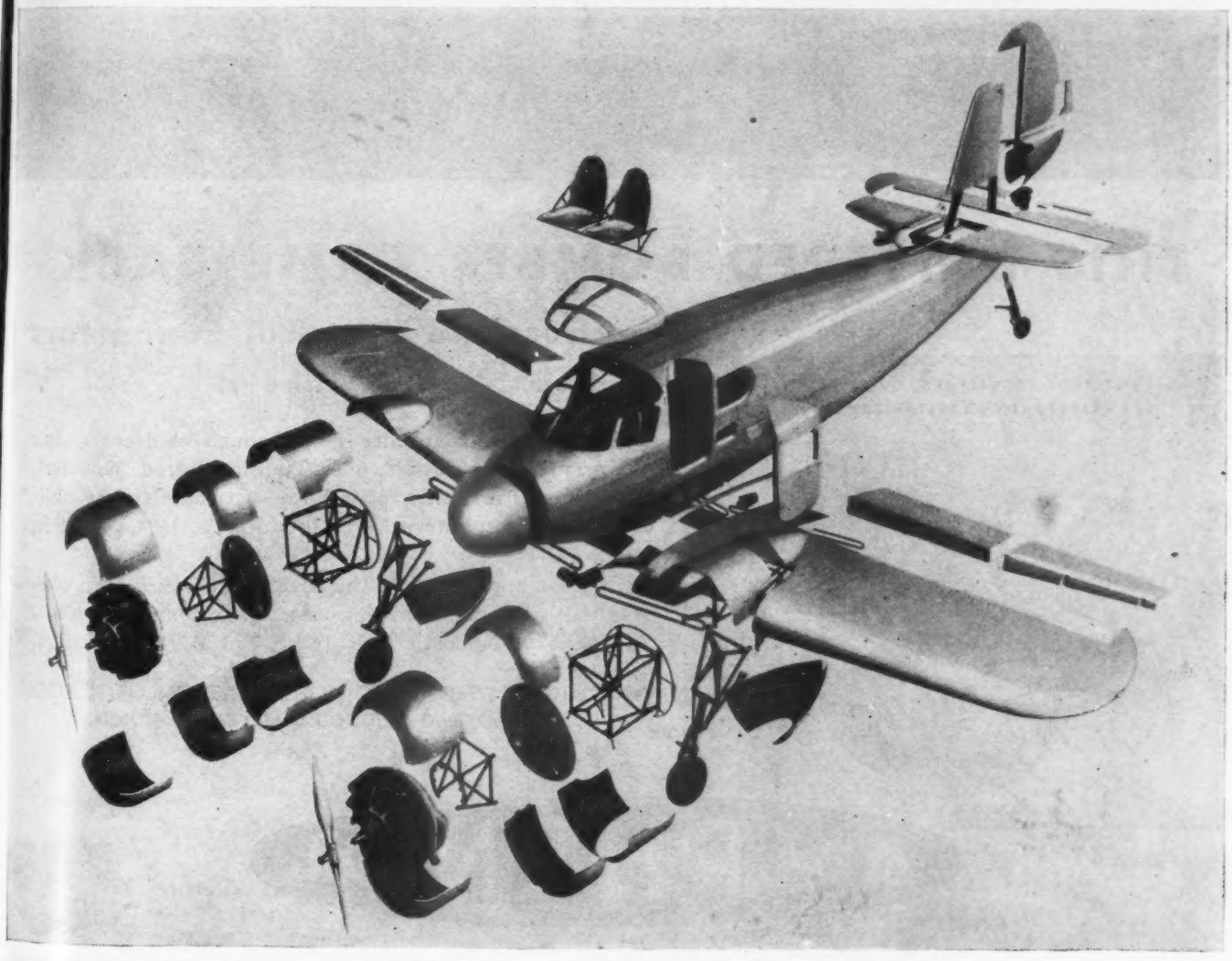
1462 OAKMAN BLVD. • DETROIT, MICH.

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921



SKETCH BOOK OF DESIGN DETAIL

Shown here is superstructure of Consolidated Vultee PBY *Catalina*, revealing mechanic's cockpit *A* at deckline, major components being solid, built-up bulkheads *B* and *C*. Wing attachment points *D* and *E* also play vital role during production, serving as holding points for locating bar to insure complete interchangeability between craft.



Exploded view showing subassemblies of the Cessna AT-17 *Bobcat*, used by Army Air Forces both as advanced trainer and personnel carrier. From an original by Wilmer Brice of Cessna engineering department.

THIS BATTERED BOMBER CAME BACK

because the Electrical Connectors could "take it"

This Martin Marauder flew through shattering flak to carry out its mission over Tunisia. Jarred, battered, torn—it still returned to its base—a tribute to the ability of American enterprise to produce the best planes in the world.

Of great importance in this feat were the electrical connectors—vital in maintaining controls and communications. Amphenol A-N Connectors are used in Martin Bombers.

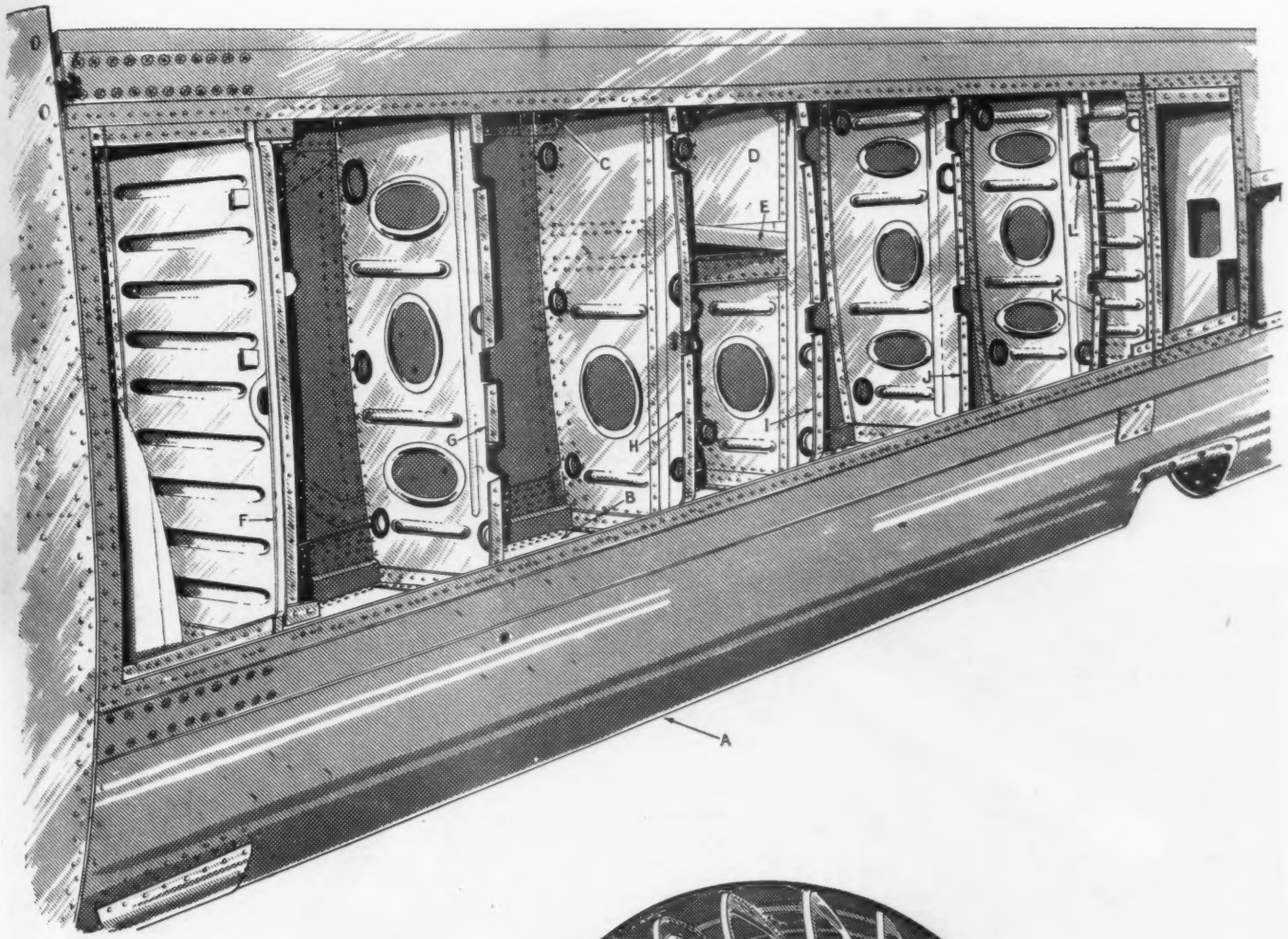
AMERICAN PHENOLIC CORPORATION, CHICAGO
IN CANADA—AMPHENOL LIMITED, TORONTO

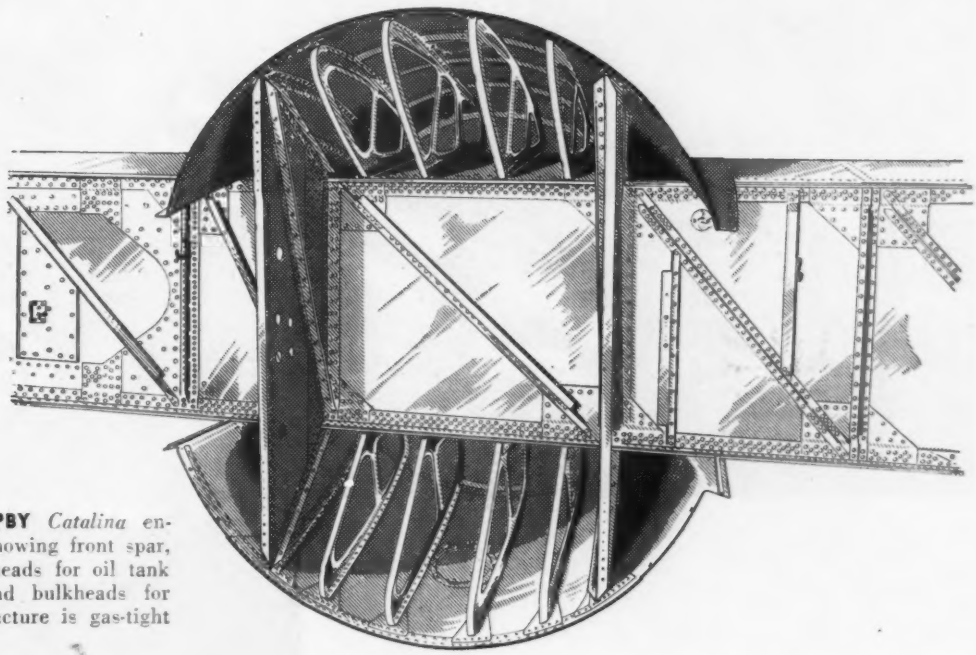
AMPHENOL

A-N ELECTRICAL CONNECTORS • CONDUIT • FITTINGS • LOW-LOSS INSULATION

SKETCH BOOK
OF DESIGN DETAIL

Bell P-39 "Airacobra" wing shown here, with leading edge *A* at bottom, is constructed around two milled, extruded aluminum spars; main, or front beam *B* and rear, or auxiliary beam *C*. Retractable landing gear spindle bearing recess *D* is formed by rear beam and bulkhead *E*. Following installation of plywood liners, self-sealing gas tanks will be inserted in recesses between stamped aluminum alloy ribs *F* through *K*. Grommets, as shown by typical example at *L*, act as cushion fairlead for fuel lines.





Consolidated Vultee PBY *Catalina* engine nacelle structure, showing front spar, main nacelle skin, bulkheads for oil tank and engine support, and bulkheads for nacelle. Behind this structure is gas-tight section of wing.

Specify SHEFFIELD ARMY-NAVY AERONAUTICAL TAPER PIPE THREAD GAGES

★ ★ ★

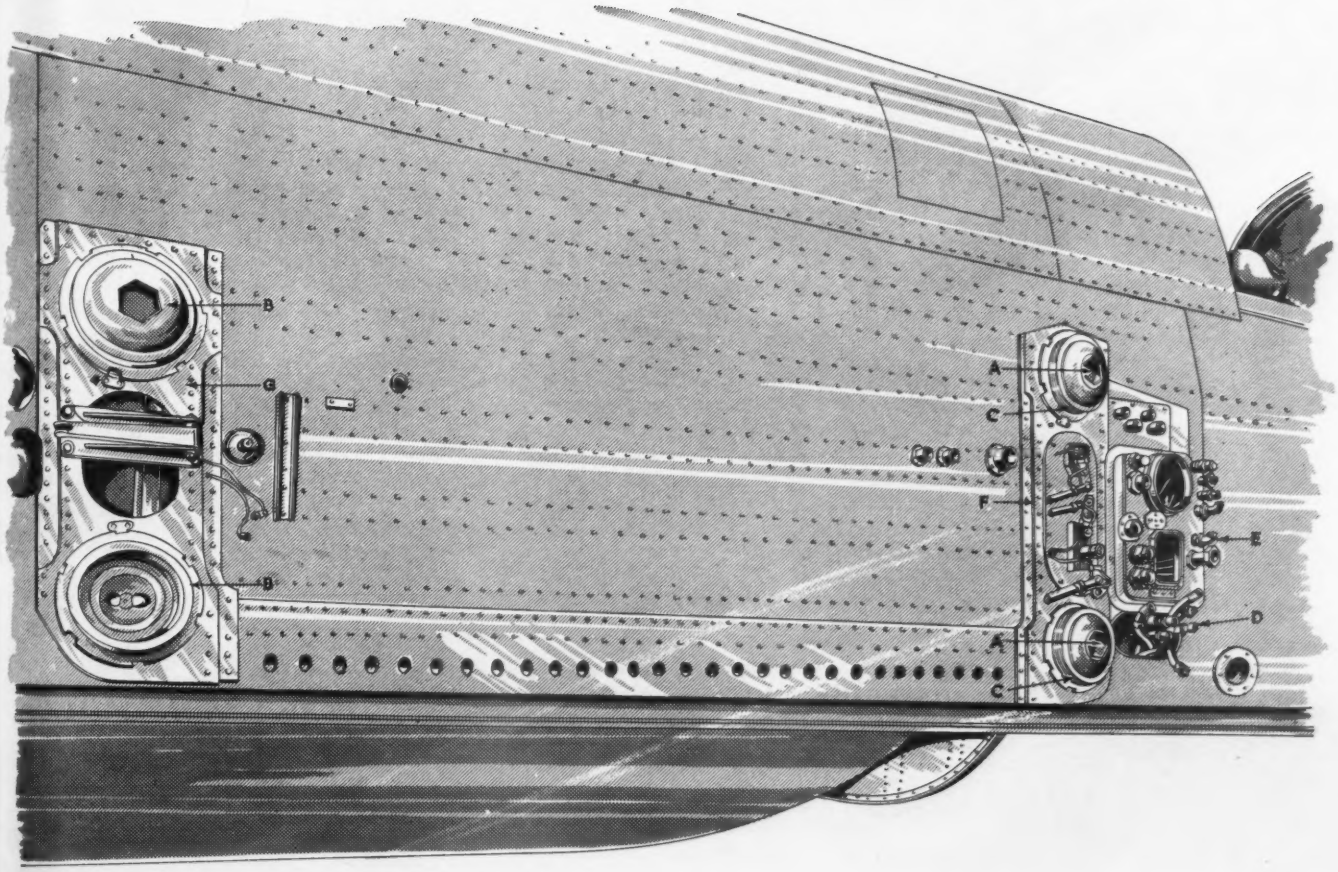
All styles of Taper Pipe Thread Gages included in Specification AN-GGG-P-363 for the inspection of aircraft fuel and oil line connections, are available from Sheffield.

Write for Bulletin #43-1 describing the use of one and three-step L_1 and L_3 plugs, 6-step plain plug, L_1 and L_2 thread rings, the 6-step plain ring—and other gages used in aircraft parts inspection.

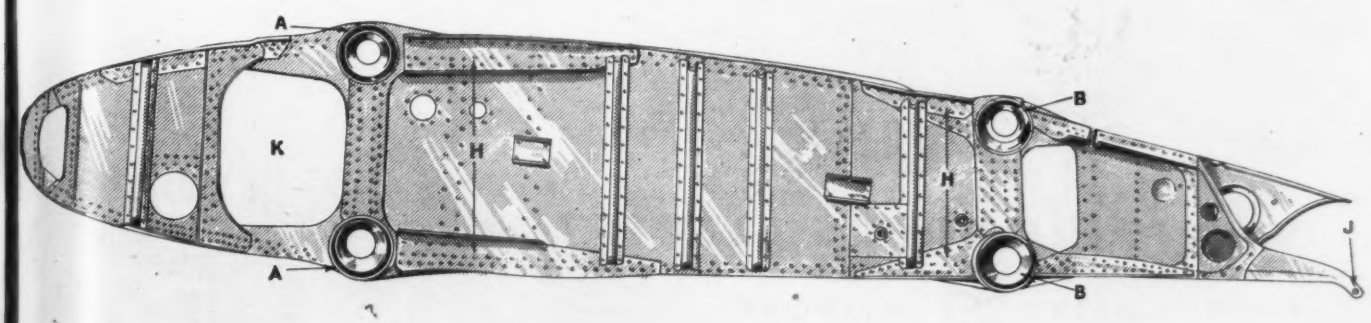
L_3 Taper pipe thread plug Nitrigage single-step, Style 4000.
L_2 Pipe thread ring Nitrigage, Style 4003.
L_3 Taper pipe thread plug Nitrigage 3-step, Style 4005.
L_1 Taper pipe thread plug Nitrigage 3-step, Style 4002.
L_1 Taper pipe thread ring Nitrigage basic, Style 4001.
L_3 Taper pipe thread plug Nitrigage single-step, Style 4004.
Plain taper ring Nitrigage 6-step, Style 4007.
Plain taper plug Nitrigage 6-step, Style 4006.
NW
MX
SHEFFIELD
MASTER GAGEMAKERS

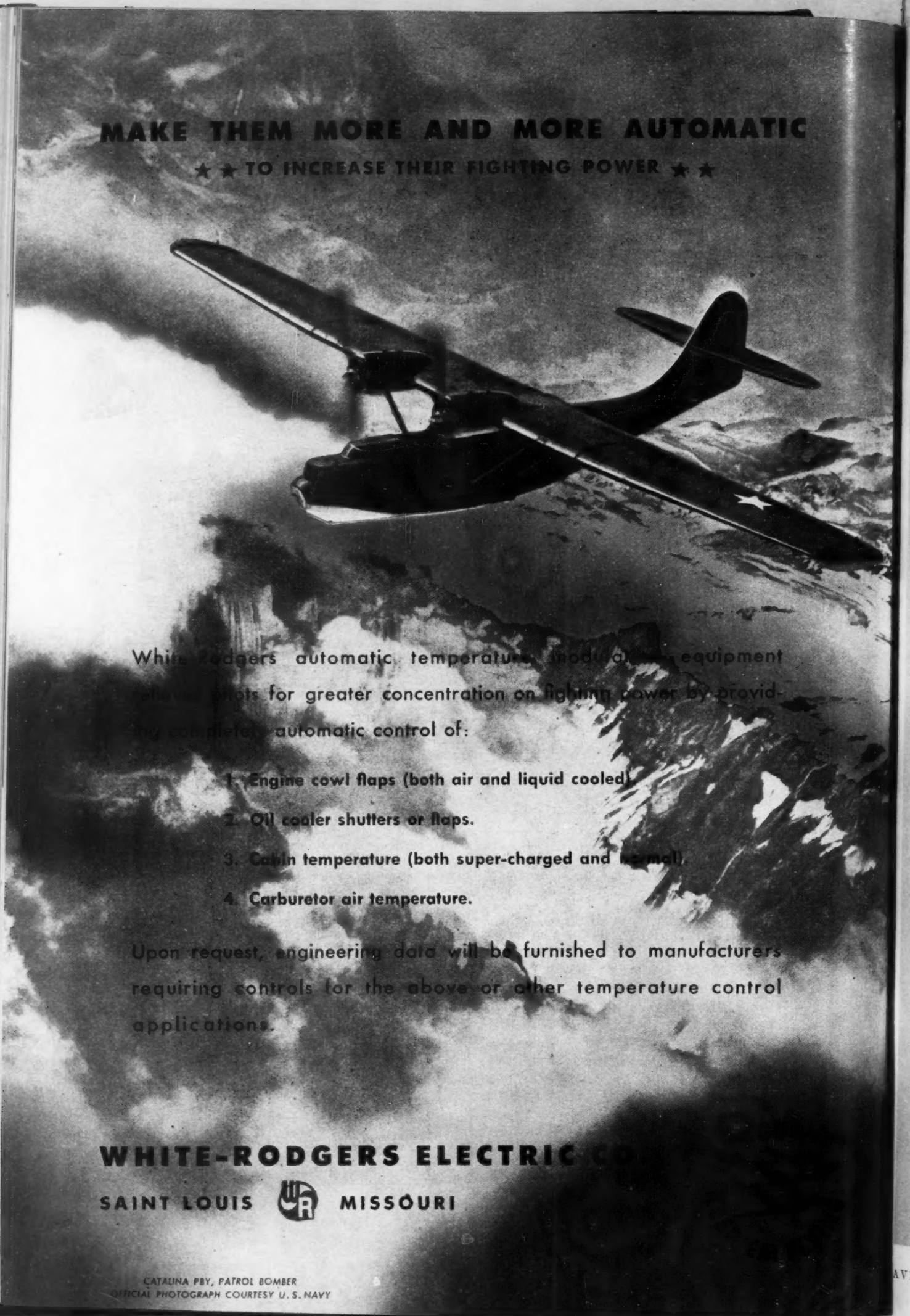
THE SHEFFIELD CORPORATION

Dayton, Ohio, U.S.A.



Wing of Junkers JU-88 follows general German practice of having quick coupling mounts. Here, four are used; front mounts at *A* and rear mounts at *B*. Mating attachments are shown in sketch below, and when wing is assembled to fuselage, threaded collar slips over fuselage mount, and is designed to permit wide tolerance between fittings, yet give rigid wing attachment. Quick detachable mounts are also used on fuel and oil lines *D* and *E*. Note reinforcement bases *F* and *G* through which wing loads are distributed into fuselage skin. Front attachment fittings *A* and rear fittings *B* below, are part of front and rear spar respectively. To take torsion and shear loads, fittings are reinforced at *H* to dissipate stress into wing. Flap is hinged at *J*, accounting for odd shape at trailing edge of wing rib. Large cutout *K* just forward of front spar affords opening through which fuel, oil, electric, hydraulic and other connections can be attached to those on fuselage.




MAKE THEM MORE AND MORE AUTOMATIC
★★ TO INCREASE THEIR FIGHTING POWER ★★
White-Rodgers automatic temperature industrial equipment
relieves pilots for greater concentration on fighting power by providing completely automatic control of:
1. Engine cowl flaps (both air and liquid cooled).
2. Oil cooler shutters or flaps.
3. Cabin temperature (both super-charged and normal).
4. Carburetor air temperature.
Upon request, engineering data will be furnished to manufacturers requiring controls for the above or other temperature control applications.
WHITE-RODGERS ELECTRIC
SAINT LOUIS MISSOURI
CATALINA PBY, PATROL BOMBER
OFFICIAL PHOTOGRAPH COURTESY U. S. NAVY

Welding of Aluminum Alloys

Machine Settings
For Producing Continuous (Gas-Tight) Seam Welds in Aluminum Alloys

Thickness of one sheet, inch	Spots per inch	"On" plus "off" time* cycles	Wheel speed,† ft./min.	"On" time cycles		Welding** pressure, lb.	Welding** current, amperes	Width of weld, inch
				Min.	Max.‡			
0.010	25	3½	3.4	½	1	420	19,500	0.08
0.016	21	3½	4.1	½	1	500	22,000	0.09
0.020	20	4½	3.3	½	1½	540	24,000	0.10
0.025	18	5½	3.0	1	1½	600	26,000	0.11
0.032	16	5½	3.4	1	1½	690	29,000	0.13
0.040	14	7½	2.9	1½	2½	760	32,000	0.14
0.051	12	9½	2.6	1½	3	860	36,000	0.16
0.064	10	11½	2.6	2	3½	960	38,500	0.19
0.081	9	15½	2.1	3	5	1090	41,000	0.22
0.102	8	20½	1.8	4	6½	1230	43,000	0.26
0.128	7	28½	1.5	5½	9½	1350	45,000	0.32

*Use next higher full cycle setting if timer is not equipped to give antipole starting of current.
†Wheel speed is adjusted to give desired spots per inch.
‡"On" time must be set at full cycle setting if "on" plus "off" time is set at full cycle setting.
**Welding pressure and welding current are adjusted to give desired width of weld. Values are for 52S-½H aluminum alloy. Use lower pressures for 52S-O or 3S-½H aluminum alloys.
Note: Wheel electrodes and work must be cooled with from 2 to 3 gal. of cool water per minute.

Electrode Size and Machine Setting
For Metal- and Carbon-Arc Welding of Aluminum

Metal thickness, inch	Electrode diameter, inch	Approximate current, amperes	Number of passes		Electrode consumption, pounds per 100 ft.			Electrodes per lb.
			Butt	Lap and Fillet	Butt	Lap	Fillet	
0.081	1/8	60	1	1	4.7	5.3	6.3	32
0.101	1/8	70	1	1	5.0	5.7	6.3	32
0.125	1/8	80	1	1	5.7	6.25	6.3	32
0.156	1/8	100	1	1	6.3	6.5	6.5	32
0.187	5/32	125	1	1	8.7	9.0	9.0	23
0.250	3/16	160	1	1	12.0	12.0	12.0	17
0.375	3/16 for laps and fillets 1/4 for butts	200	2	3	25.0	29.0	35.0	17
0.500	3/16 for laps and fillets 1/4 for butts	300	3	3	35.0	35.0	35.0	17

Exploding old assembly methods..

The spring tension principle of the SPEED NUT SYSTEM has revolutionized assembly methods everywhere. Now, in many cases, one SPEED NUT performs multiple functions, reduces number of parts, eliminates handling operations and drastically cuts weight and production costs.

For example: Our complete line of SPEED NUT angles combines the angle bracket and fastener into a single part. Self-retaining SPEED NUTS for all types of conduit clamps speed up assembly by eliminating unnecessary handling of parts. SPEED NUT retainer rings cut riveting operations to a minimum and save both in material and weight. SPEED NUT strips replace extruded gang channels. And our triangular nut plate for attachment of running lights, cuts riveting operations from 6 to 1. These are only 5 out of dozens of SPEED NUT designs that have virtually exploded conventional assembly methods. Write for our new summary catalog No. 185.

TINNERMAN PRODUCTS INC. • 2070 Fulton Rd., Cleveland, Ohio

IN CANADA: Wallace Barnes Co., Ltd., Hamilton, Ontario

IN ENGLAND: Simmonds Aerocessories, Ltd., London

Speed Nuts **FASTEST THING IN FASTENINGS!**

Welding of Aluminum Alloys

Machine Settings For A.C. Spot Welding Aluminum Alloys

Gage		Time, cycles	Current, amperes	Tip pressure, lb.	
B. & S. No.	Inch			Min.	Max.
26	0.016	4	14,000	200	400
24	0.020	6	16,000	300	500
22	0.025	6	17,000	300	500
20	0.032	8	18,000	400	600
18	0.040	8	20,000	400	600
16	0.051	10	22,000	500	700
14	0.064	10	24,000	500	700
12	0.081	12	28,000	600	800
10	0.102	12	32,000	800	1,000
8	0.128	15	35,000	800	1,200

Minimum Shear Strength of Spot Welds in Aluminum Alloys

Thickness of one sheet of two equal thicknesses welded, inch	Alloy welded						
	2S-½H 2S-H	3SO	3S-½H 3S-H	52SO	52S-½H 52S-H	53SW 53ST 61SW 61ST	24ST and Alclad 24ST
	Lb./spot	Lb./spot	Lb./spot	Lb./spot	Lb./spot	Lb./spot	Lb./spot
0.016	40	40	55	90	90	90	120
0.020	55	55	75	120	120	120	160
0.025	70	70	100	170	170	170	215
0.032	110	110	140	240	240	240	300
0.040	150	140	190	340	340	340	430
0.051	205	180	280	500	510	510	620
0.064	280	250	390	700	720	720	840
0.081	420	340	570	940	1,000	1,000	1,080
0.102	520	480	800	1,210	1,320	1,320	1,320
0.125	590	710	1,000	1,450	1,620	1,620	1,450

Values given in this table are about 65 percent of average strength obtained when weld diameter is twice the thickness plus $\frac{1}{16}$ in.

Courtesy of
Aluminum Company of America

Approximate Machine Settings Atomic-Hydrogen Welding

($\frac{1}{16}$-*in. Dia. Electrodes*)

Thickness, inch	Current, amperes	Hydrogen pressure, lb. per sq. in.	Filler wire diameter, inch
0.064	10	7	$\frac{1}{8}$
0.081	15	7	$\frac{5}{32}$
0.101	21	8	$\frac{5}{32}$
0.125	27	8	$\frac{3}{16}$
0.187	33	11	$\frac{3}{16}$
0.250	39	14	$\frac{3}{16}$
0.375	45	14	$\frac{1}{4}$

Approximate Size of Tips and Relative Gas Pressures Used in Welding Aluminum of Various Thicknesses

Metal thickness, B. & S. gage	Oxyhydrogen			Oxyacetylene		
	Diameter of orifice in tip, inch	Oxygen pressure, lb./sq.in.	Hydrogen pressure, lb./sq.in.	Diameter of orifice in tip, inch	Oxygen pressure, lb./sq.in.	Acetylene pressure, lb./sq.in.
24–22	0.035	1	1	0.025	1	1
20–18	0.045	1	1	0.035	1	1
16–14	0.065	2	1	0.055	2	2
12–10	0.075	2	1	0.065	3	3
$\frac{1}{8}$–$\frac{3}{16}$	0.095	3	2	0.075	4	4
$\frac{1}{4}$	0.105	4	2	0.085	5	5
$\frac{5}{16}$	0.115	4	2	0.085	5	5
$\frac{3}{8}$	0.125	5	3	0.095	6	6
$\frac{5}{8}$	0.150	8	6	0.105	7	7

Review of Patents

By A. HARRY CROWELL,
Registered Patent Lawyer

FOLLOWING are digests of some of the more significant recent patents on aviation developments granted by the U. S. Patent Office. Mr. Crowell will be glad to furnish readers information, without charge or obligation, on approximate cost and procedure in applying for patents and trademark registrations. Address inquiries to him, care AVIATION, 330 W. 42nd St., New York. Printed copies of any of the patents listed below are obtainable at 10¢ each directly from U. S. Patent Office, Washington.

Hydraulic Control System for aircraft utilizes an electrical synchronizing gear designed to maintain automatically proper synchronism between pilot control and control surface—2,315,270, filed Feb. 26, 1941, issued Mar. 30, 1943, R. W. Palmer, assignor to Vultee Aircraft.

Automatic Flap Control is device to return airplane flaps to inoperative position when air pressure exerted on them exceeds a predetermined point, thus threatening to become dangerous.—2,316,235, filed Oct. 23, 1940, issued Apr. 13, 1943, E. Glast, vested in Alien Property Custodian.

Means for Controlling Air supply to closed cabins of aircraft is arrangement to furnish air under pressure at high altitudes while maintaining suitable temperature in this injected air.—2,316,237, filed Jan. 4, 1941, issued Apr. 13, 1943, S. Grumert, vested in Alien Property Custodian.

Aircraft Altitude Spacing System incorporates means of signaling pilot whenever he has varied his altitude outside of predetermined limits. Purpose is to maintain specific altitudes of flights of planes which are using the same airways so that collisions will be prevented.—2,316,411, filed Aug. 29, 1941, issued Apr. 13, 1943, M. J. Finnegan, assigned to Bendix Aviation Corp.

Construction Material for Aircraft. Object of this patent is a special reinforcing of material sheets from which walls or skin of aircraft are constructed. Reinforcement is stated to be equal to the double crossed corrugated sheet system but much lighter and more compact.—2,316,569, filed Apr. 18, 1939, issued Apr. 13, 1943. C. Dornier, vested in Alien Property Custodian.

Landing Gear Control System. This is adapted to raise or lower the landing gear automatically when certain predetermined safe or unsafe conditions of the flight of the airplane have occurred.—2,316,682, filed May 31, 1941, issued Apr. 13, 1943, M. J. Finnegan, assigned to Bendix Aviation Corp.

Tank for Use in Aircraft. This is unit developed to hold lubricating oil and maintain the oil around feed port so that sudden movements of plane will not interfere with flow of lubricant to engine.—2,316,729, filed May 12, 1942, issued Apr. 13, 1943, H. C. Tryon, assigned to D. Napier & Son, Ltd.

Aircraft Propeller Hub of split type is constructed so that in mounting blades and hub transverse displacement of hub halves is prevented and halves are balanced.—2,317,629, filed Mar. 27, 1941, issued Apr. 27, 1943, E. G. McCauley.

Remote Indicating Compass is device to electrically control a remote pointer from a master compass and travel through 360 deg. without re-setting of either remote pointer or master compass.—2,316,873, filed Oct. 19, 1939, issued Apr. 20, 1943, P. Kollman, assigned to Square D Co.

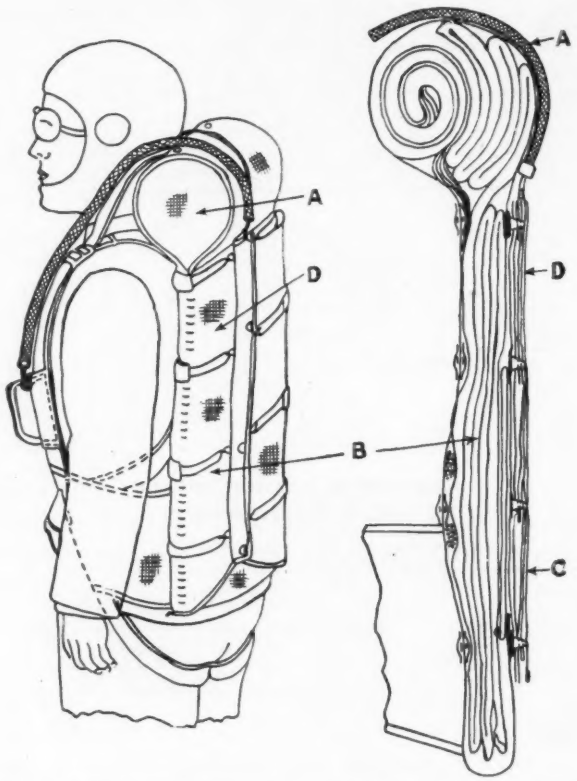
Aircraft Wing System has been projected to provide auxiliary wings, which would normally be contained in pockets on upper surfaces of right and left main wing. These auxiliary airfoils would be power-raised into position to give added wing surface when needed. Meanwhile a flexible cover is designed to close automatically the pockets thus left in main wings.—2,317,267, filed Mar. 15, 1940, issued Apr. 20, 1943, A. Gazda, vested in Alien Property Custodian.

Float for Aircraft. This device would automatically be released when aircraft crashes and submerges in water. In addition, float features a light to attract salvage crews.—2,317,285, filed June 15, 1942, issued Apr. 20, 1943, E. B. Marple.

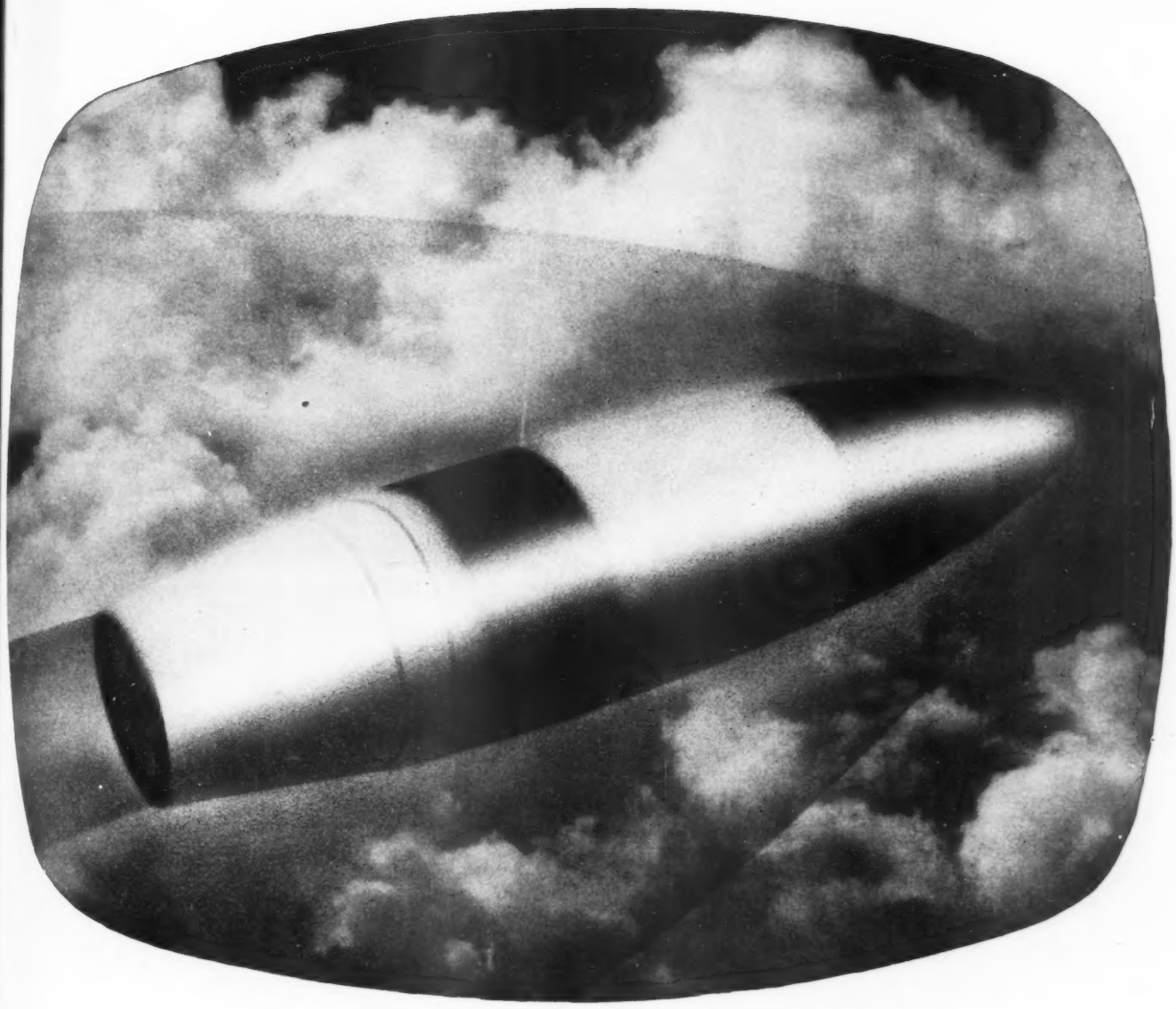
Rotary Wing Aircraft, calling for a sustaining rotor and propulsive airscrews features counteracting of torque reaction of rotor by means of a system for yawing or offsetting rotor from longitudinal axis of aircraft.—2,317,342, filed Apr. 6, 1940, issued Apr. 27, 1943, C. G. Pullin, assigned to Autogiro Co. of merica.

Dirigible Control System. Patent deals with automatic means to equalize high and low speed turning moments of lighter-than-air craft controlled by magnetic compasses. —2,317,383, filed Jan. 27, 1940, issued Apr. 27, 1943, H. L. Hull, assigned to Sperry Gyroscope Co.

Control Stick for Aircraft. This unit is formed from tubular telescopic members and thus is adjustable. Stick may be used with both or only one of tubular members, whichever is desired.—2,317,818, filed Dec. 4, 1941, issued Apr. 27, 1943. J. Skulkety.



To reduce bulkiness of parachute pack along pilot's spine, new case has substantial portion of chute canopy including skirt folded in pillow-like pack *A* behind flyer's neck. A limited number of folds and the canopy peak flow down the back in flat case *B*. Cutaway view of this arrangement shows how pilot chute *C* is placed directly below side flaps *D*, through which it is thrust by a spring, whereupon main canopy would follow. Veteran Floyd Smith, designer of device, says "the invention is capable of varied modifications."—2,316,896, filed Nov. 15, '39, issued, Apr. 20, '43, assigned to Pioneer Parachute Co.



It traveled more than 99.9% of the way on gasoline

This is a 37-mm. shell just about to complete the last five hundred yards of a five-hundred-mile journey from an American air base to the innards of a Jap Zero.

It got its last burst of speed from a charge of smokeless powder. But most of the way this shell, and the cannon that fired it, the pilot that aimed it and the plane that carried it—all four—were "propelled" by a gasoline engine.

That's why gasoline quality means so much in warfare today. The better the gasoline, the more power engine-builders can design into their engines—and the more shells and bombs we can place where they'll do the most good.

On its own initiative our petroleum industry has for years been engaged in research to improve aviation fuels and methods of producing them. The result is that today American refiners can supply our fighting forces with vast quantities of high-octane aviation fuel.

There is a generous portion of Ethyl antiknock fluid in all U. S. "fighting grade" gasoline. Added to the high quality gasoline produced by modern methods, it boosts its octane (antiknock) rating still higher. Today this super-gasoline "with Ethyl" is helping America fight. Tomorrow, with Victory, it will contribute to American commercial supremacy in the air.

ETHYL
BRAND OF ANTIKNOCK COMPOUND
ETHYL CORPORATION
TRADE MARK REG. U.S. PAT. OFF.

ETHYL CORPORATION

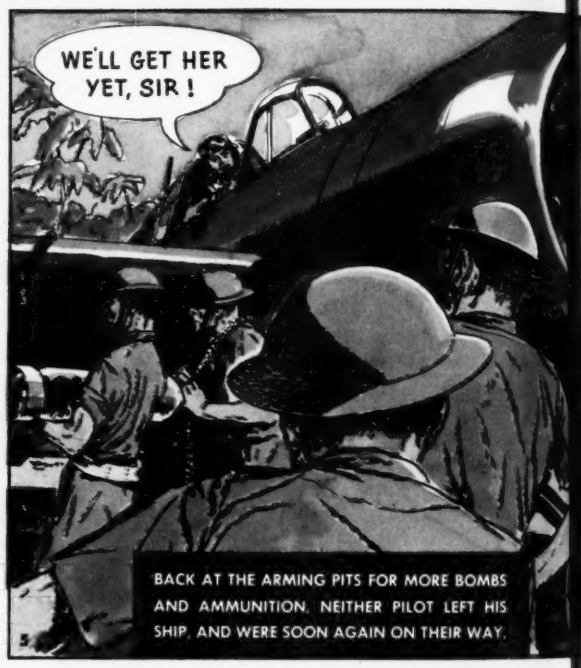
Chrysler Building, New York City

Manufacturer of Ethyl fluid, used by oil refiners to improve the antiknock quality of aviation and motor gasoline.

U.S. MARINES FLYING GRUMMAN WILDCATS SINK BIG JAP CRUISER OFF WAKE ISLAND!

AFTER 4 DAYS OF CONTINUAL COMBAT AGAINST THE JAP AIR FORCE, WEARY MARINE PILOTS ON WAKE ISLAND HAD ONLY 4 GRUMMAN WILDCATS LEFT TO HOLD OFF TOJO'S ONCOMING INVASION FLEET . . . TWO PILOTS VOLUNTEERED TO ATTACK THE BIG CRUISER FLAGSHIP IN THEIR LITTLE SINGLE-SEATER F4F FIGHTERS.

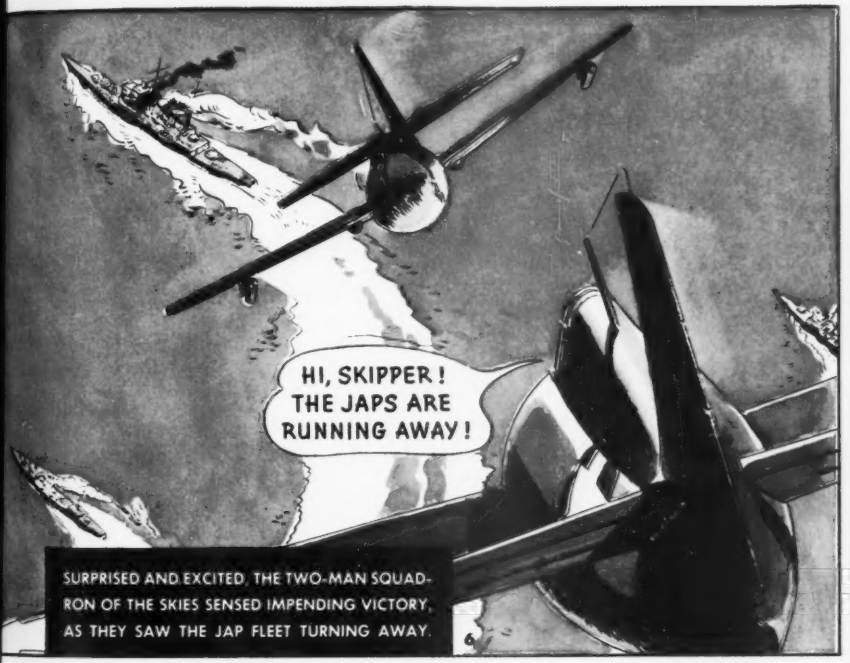
ROARING THROUGH SPACE THE TWO GRUMMAN WILDCATS DOVE TO THEIR FIRST ATTACK WITH ALL MACHINE GUNS CHATTERING. EACH RELEASED TWO BOMBS, ONE OF WHICH SCORED A DIRECT HIT.

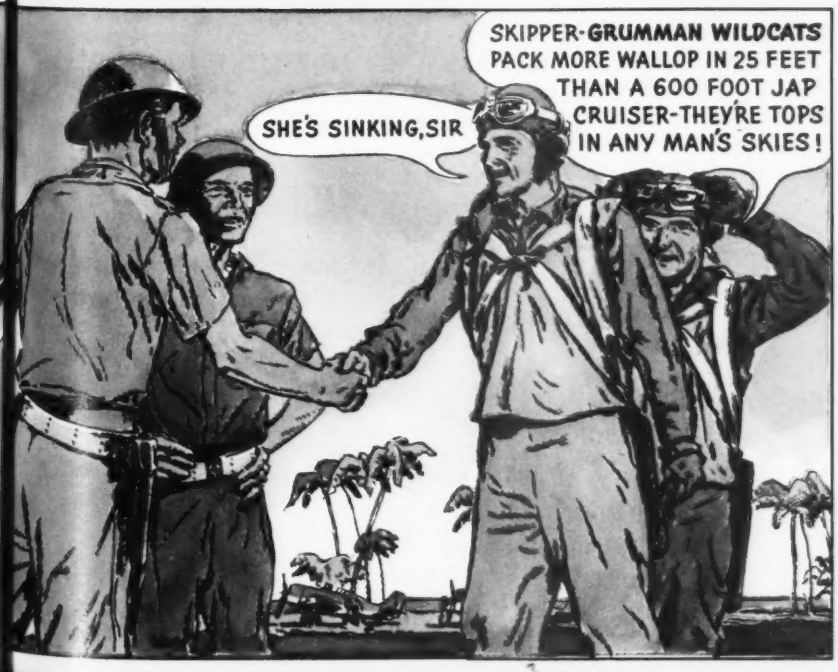


BACK AT THE ARMING PITS FOR MORE BOMBS AND AMMUNITION, NEITHER PILOT LEFT HIS SHIP, AND WERE SOON AGAIN ON THEIR WAY.

DIVING THROUGH SCREEN OF HEAVY ANTI-AIRCRAFT FOR FOURTH TIME, THE WILDCAT PILOTS SENT HOME LAST OF 8 SUCCESSFUL BOMB HITS . . . STRAFED THE CRUISER'S DECK WITH MACHINE GUNS . . . REPORTED JAP FLAGSHIP BLAZING STEM TO STERN . . . FLAMES LICKING AT HER MAGAZINES . . . HER CREW GOING OVERBOARD IN HEADLONG CONFUSION . . . THIS PROVED TO BE THE FIRST CAPITAL SHIP IN HISTORY SUNK BY SMALL FIGHTER PLANES.

I'M GOING DOWNSTAIRS AND FAKE A FRONTAL ATTACK TO DRAW THEIR FIRE. YOU COME IN FROM THE SIDE.
ZOOMING AT A PERILOUS ANGLE TO GAIN ALTITUDE QUICKLY OVER THEIR TARGET, THE PILOTS WERE SOON IN POSITION FOR THEIR DESPERATE DIVES.


HI, SKIPPER! THE JAPS ARE RUNNING AWAY!
SURPRISED AND EXCITED, THE TWO-MAN SQUADRON OF THE SKIES SENSED IMPENDING VICTORY, AS THEY SAW THE JAP FLEET TURNING AWAY.


SHE'S SINKING, SIR
SKIPPER-GRUMMAN WILDCATS PACK MORE WALLOP IN 25 FEET THAN A 600 FOOT JAP CRUISER-THEY'RE TOPS IN ANY MAN'S SKIES!

Grumman
MAKES PLANES THAT MAKE HISTORY
GRUMMAN AIRCRAFT ENGINEERING CORPORATION • BETHPAGE, LONG ISLAND

There's Stamina and Performance

with

McQUAY-NORRIS

ALTINIZED

PISTON RINGS

PISTONS..PINS..

HARDENED & GROUND PARTS

McQuay-Norris, a pioneer manufacturer of parts in the automotive field, is devoting itself in increasing measure to the aviation industry. Our Aircraft Division projects the McQuay-Norris policy of clinical research into this important field with the result that we are continually adding to available parts, technical assistance and research experience. Your inquiries are invited.

PARTS FOR AIRCRAFT ENGINES

Piston Rings
Oil Sealing Rings
Supercharger Rings
Carburetor Parts
Machined Aluminum Pistons
Piston Pins
Counterweight Cheek Pins
Machined Magnesium Parts
Cylinder Hold Down Nuts
Hardened and Ground Parts

PARTS FOR PROPELLER ASSEMBLY

Machined Magnesium Parts
Piston Rings

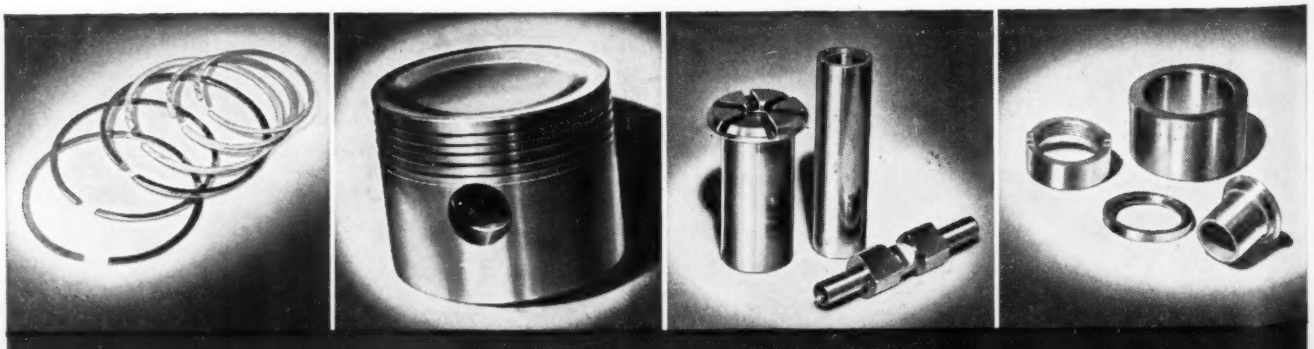
EQUIPMENT FOR MAINTENANCE OF AIRCRAFT

Pistons for Oxygen Compressor
Piston Rings for Oxygen Compressor
Pins for Oxygen Compressor
Pistons for Air Compressor
Pins for Air Compressor
Piston Rings for Air Compressor

LANDING GEAR PARTS

Machined Aluminum Pistons
Piston Rings
Hardened and Ground Parts

PRECISION WORKERS IN IRON, STEEL, ALUMINUM, BRONZE, MAGNESIUM



McQUAY-NORRIS MFG. CO. (AIRCRAFT DIVISION) ST. LOUIS, U.S.A.
CANADIAN PLANT, TORONTO, ONTARIO

SIDE SLIPS

SITTING FOR FIVE HOURS on the hard, hard benches of a metropolitan airport waiting connections the other night, Side Slips got a new slant on this ferry pilot business. Naturally envious of the lads who fly any and all types of aircraft all over the country, we thought they led the life of Riley all the time. And, like many another non-priority civilian, we have often quavered inwardly when a bunch of them appeared at the ticket counters. We did just that, the night in question, when six of them showed up, got their return tickets (on another line) and took their places quietly on the aforesaid hard, hard bench.

After some two hours, one of them gazed longingly up at a very empty, very spacious balcony surrounding the waiting room and said wistfully, "Look at all that space going to waste. Wouldn't it be swell if they'd put in some cots—or even just some soft chairs—for tramps like us?"

Many of our cities and towns have been bragging for years about their wonderful airports; many of the same cities and towns are now bustling with Service Clubs, Canteens, and what-have-you. Just a wee bit of coordination could add a great deal to the life of a lot of lads who'd rather be flying in combat, but who do the job they're told to do.

• It's open season, gentlemen. We mean that at last you can speak above a whisper when you mention five new planes, skip bombing, and what the Army and Navy think about dive bombing. Yes, a lot of our strategy is finally out in the open.

For that you can thank the Truman Committee's latest report. However, there is also much in the document for which it is difficult to be thankful: a large part of it seems to be whipping a dead horse. There is nothing that was unknown to the Army, Navy and companies involved; nothing, as Under Secretary Patterson was quick to point out, about which corrective measures had not long since been taken. This is by no means a denial that the aircraft industry has made mistakes. It would be humanly impossible not to err while expanding as fast and as far as aviation has had to expand—possibly to cover mistakes of so-called public servants who withheld expansion funds for the Army and Navy when it was first needed.

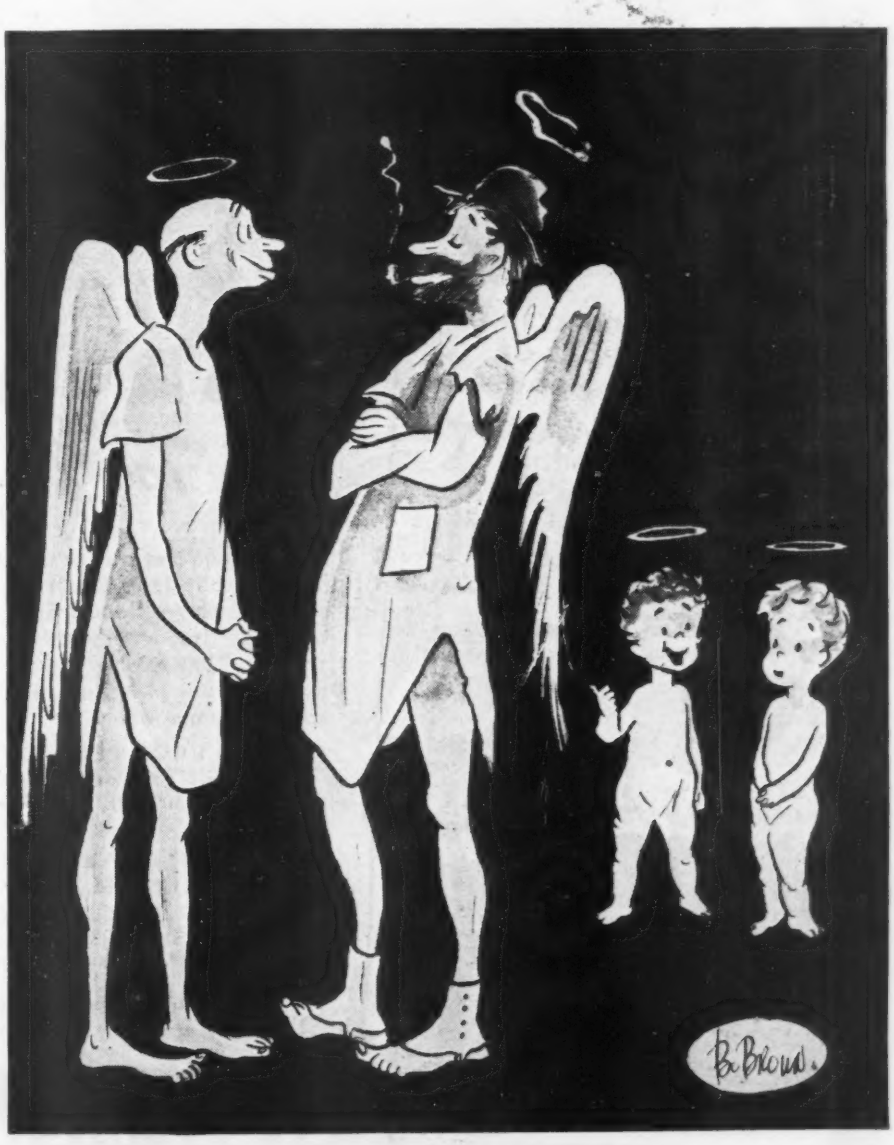
Instead of beating defunct dobbins, it would seem much more worthwhile if such groups spent the same time and energy on some home front items still sadly in need of attention. Such items, for example, as a clear-cut policy on contract renegotiation and termination, some semblance of an international airline policy, or the location of sources where the manufacturers may get the extrusions they need to build the airplanes the public servants want all of a sudden.

• Most of the stories of grossly overloaded planes seem to have come from China—maybe because there aren't any CAA inspectors over there to make sure that design gross-weights are complied with. But, in military operations at least, there are some pretty good ones cropping up right here at home.

For instance, there's the pilot who left a depot in a Curtiss C-46 *Commando* for a coastal port. His non-stop trip was uneventful; to him it seemed just like another jaunt. But when the boys started to unload the ship, and the cargo kept coming, seemingly without let-up, out the door, they got more than a little curious. One of them did some checking and nearly fainted when he found the craft had been taken off with 60,000 lb. gross—just 15,000 more than design gross-weight.

• GOING DOWN a fighter production line minding his own business the other day a friend got whistled at three times by members of the so-called weaker sex. What, he wants to know, shall he do when that plant's feminine employment goes from its present 35 to a projected more-than-50 percent?

Quietly resign in our favor, chum, if for nothing other than letting us learn what it's like to be whistled at by something besides a cop.



Maguire's brother, "Hobo Jim", rode the rods on the first sky freight train to fly the Atlantic!

These WAR WEAPONS Are Too Valuable To Waste

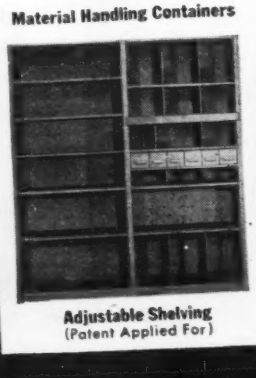
THESE LYON PRODUCTS HELP MAKE THE MOST OF AVAILABLE MANPOWER

3-Shift Work Benches

Bench Legs

Material Handling Containers

Tool Stands



Adjustable Shelving (Patent Applied For)

Shoprobes (Patent No. 2-202-427)

The present manpower shortage has multiplied the importance of saving *hand* mileage and *foot* mileage for every available worker. That is one reason why so many war plants are making extensive use of:

1. LYON SHOP PRODUCTION EQUIPMENT: Work Benches — Material Handling Containers — Tool Stands and Cases, etc.

2. LYON STORAGE EQUIPMENT "ENGINEERED IN WOOD FOR THE DURATION": Adjustable Shelving — Portable Shoprobes—Lockers—Cabinets.

When Lyon equipment is on the job, unneccessary hand motions are eliminated, time-wasting trips for tools and materials are avoided . . . jobs move ahead faster. Equally important, accident hazards are reduced, fewer tools are lost or damaged, and workers' energy is conserved.

Write for Lyon Catalogs

LYON METAL PRODUCTS, INCORPORATED

General Offices:
5808 Madison Avenue, Aurora, Illinois

Branches and Distributors in All Principal Cities

LYON METAL PRODUCTS INCORPORATED

SUBCONTRACTORS SECTION

Fairchild "Gunner" Largely Subcontracted

Twenty-one manufacturers, including five in North Carolina, now hold subcontracts for parts of the Fairchild *Gunner*, two-engine advanced trainer now going into large scale production at the company's new plant in Burlington, N. C. The manufacturing program calls for subcontracting of approximately 60 percent of the plane, according to Lee H. Smith, general manager of the Burlington plant.

The largest subcontract to date has been awarded to the Drexel Furniture Co., of Drexel, Marion, and Morganton in North Carolina. Nominally producers of furniture, the Drexel organization is converting a large part of its facilities to make flap assemblies, outer wing panels, fin assemblies, rear fuselages, and other components of the *Gunner*.

New Procedure For Acquiring Equipment

Methods for reviewing applications placed with Army, Navy, or other governmental agencies for new machine tools and capital equipment have been established by the War Production Board's new Directive 23, which supersedes Priorities Directive No. 2.

Under the new system this work is done, insofar as is possible, in the WPB field offices to make it possible to enlist readily the local available existing equipment of subcontracting facilities. Under the new set-up, WPB is given ten days to determine the availability of used or subcontracting facilities, and provision is also made for the appeal of disapproved applications by service officers through the board's Facilities Bureau.

The move is in line with the recently announced policy whereby WPB's approval is mandatory on all applications for new equipment costing over $500, and further that approval cannot be given if suitable existing equipment or subcontracting facilities are immediately available. WPB field offices within whose jurisdiction the tools or equipment are to be located may approve or disapprove applications for new equipment costing up to $100,000, and they may receive applications for projects costing more than that amount, recommending to the Facilities Bureau what action should be taken.

The WPB announcement pointed out that in all cases no rating for new machine tools and capital equipment costing over $500 may be issued without the counter signature of the field office having jurisdiction, adding that purchases may not be divided to bring the cost below $500.

Making Sub-Systems Permanent

Although large prime contractors are devoting practically all their attention to the nation's number one job—winning the war—many of them are considering postwar operations which will materially benefit their successful subcontractors.

These organizations, a recent survey reveals, are planning for permanent tie-ups with subcontractors—on the products they are now turning out for the armed forces, for products they built before the war, or in some cases new items never before undertaken. One such prime contractor, for example, is writing a postwar clause into its agreements with subcontractors whereby it gets first call on their productive capacity when hostilities cease.

This means, it is pointed out, that many firms now engaged in making aircraft parts will be able to continue after the war in a productive association with their wartime prime contractors.

CMP Guide Available

WPB district offices are now issuing a digest titled, *Handy Guide and Outline of Procedure under the Controlled Materials Plan*. CMP, of course, affects subcontractors as well as prime contractors.

Cross indexed to the regulations for quick reference, the digest is designed to give manufacturers a quick picture of what to do regarding CMP procedures.

Are you interested in: (1) Reducing time and cost of handling tools and materials; (2) Saving floor space; (3) Increasing protection against fire, sabotage and personal injury hazards?

This comprehensive catalog contains many suggestions for meeting these war-time problems. It illustrates and describes many types and sizes of shop boxes, work benches, portable tool stands and many other items that manufacturers of Airplanes and Airplane Parts are finding most effective in every production operation.

Mail coupon today for your copy of this useful book.

LYON METAL PRODUCTS, INCORPORATED
Sales and District Offices Manned by Experienced Engineers in All Principal Cities

LYON SHOP EQUIPMENT *Service*

LYON METAL PRODUCTS, INCORPORATED
5808 Madison Avenue, Aurora, Illinois
Send FREE copy of Lyon Shop Equipment Catalog.

Name_____

Address_____

City_____ State_____

Aircraft Parts from America's New Source of Aluminum

To the aircraft industry, Reynolds means complete Service in Aluminum. Reynolds mines its own bauxite, processes the ore into finished aluminum and then carries the service through to the final vital operation—*fabricated parts for planes.*

Reynolds was the first to produce high grade metal from lean domestic ore and was the first aluminum company to fabricate finished airplane parts.

Now Reynolds is mining more bauxite than was mined in the entire country before the war, converting it into hundreds of millions of pounds of aluminum for aircraft. The Parts Division in Louisville, expanded 40 times, has thousands of workers and batteries of machines on 24-hour schedules.

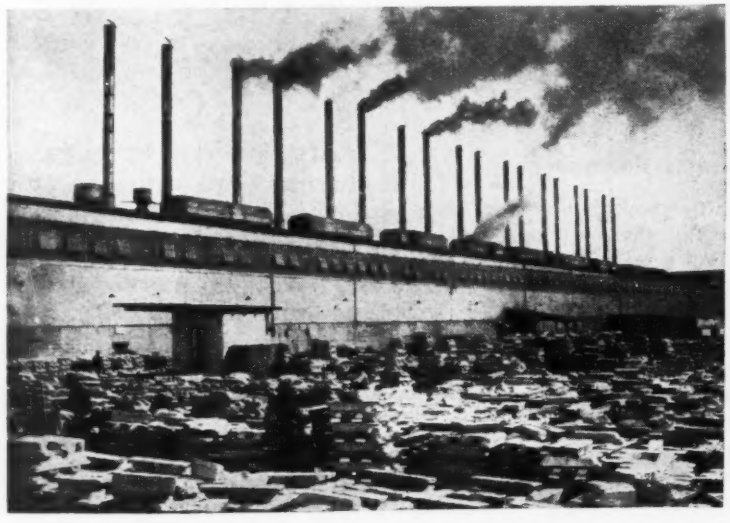
Scrap from fabricating operations (average 30 percent) stays at Reynolds plants, where it is put right back into production. This eliminates scrap headaches for aircraft manufacturers . . . *saves manpower, plant space, freight facilities . . . and keeps inventories down!*

The foresight and courage that created America's New Source of Aluminum has developed the aircraft industry's new source for finished parts. Reynolds Sales Engineers are available throughout the United States.

REYNOLDS METALS COMPANY • PARTS DIVISION • LOUISVILLE • KY.

AMERICA'S NEW SOURCE OF ALUMINUM

INGOT • SHEET • EXTRUSIONS • WIRE • ROD
BAR • FORGINGS • TUBING • FOIL • POWDER



3 Aluminum ingots, outside Alabama plant, are fed into remelt furnaces with alloying metals. Resulting alloys are cast into billets.

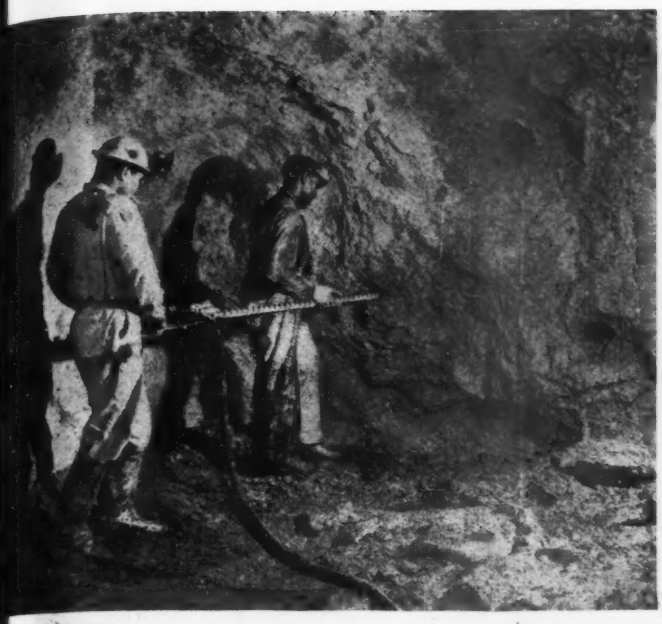
4 Reynolds rolled aluminum alloy forging stock, tested and inspected, ready to be forged into aircraft propellers.

7 Reynolds Parts Division Shearing Line, capacity 4,000,000 lbs. of sheared skins monthly. All skins Navy inspected.

(No Scrap Problems)

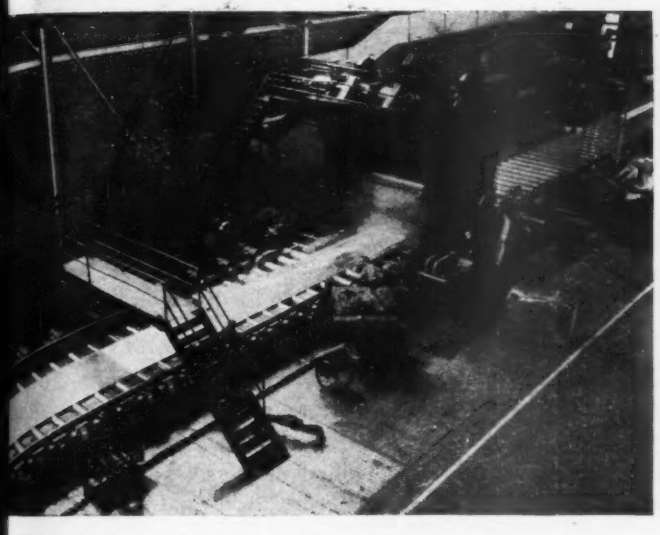
8 Reynolds Router and Stack Drill Department, section of the 250,000 sq. ft. expansion of the Parts Division in Louisville.

(No Scrap Problems)

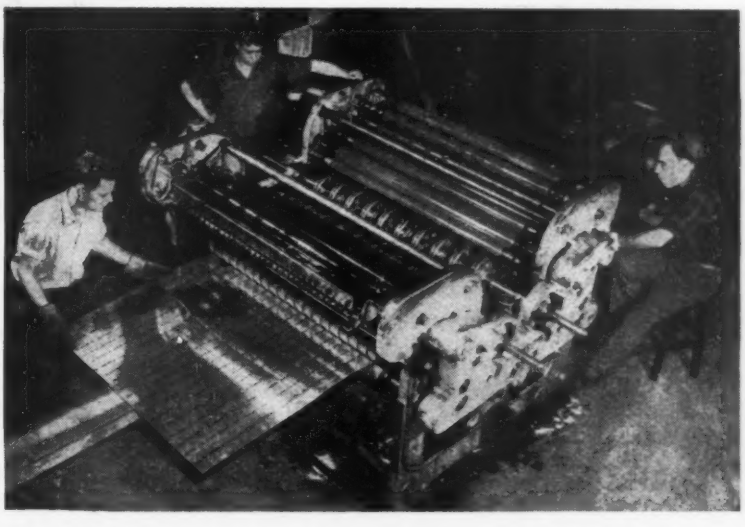


1 Reynolds Aluminum and finished parts start in this Arkansas bauxite mine. Reynolds mines more bauxite than was ever mined in the U. S.

2 Reynolds refines bauxite into alumina; reduces alumina into aluminum; aluminum is cast, alloyed and fabricated into sheet and rod.

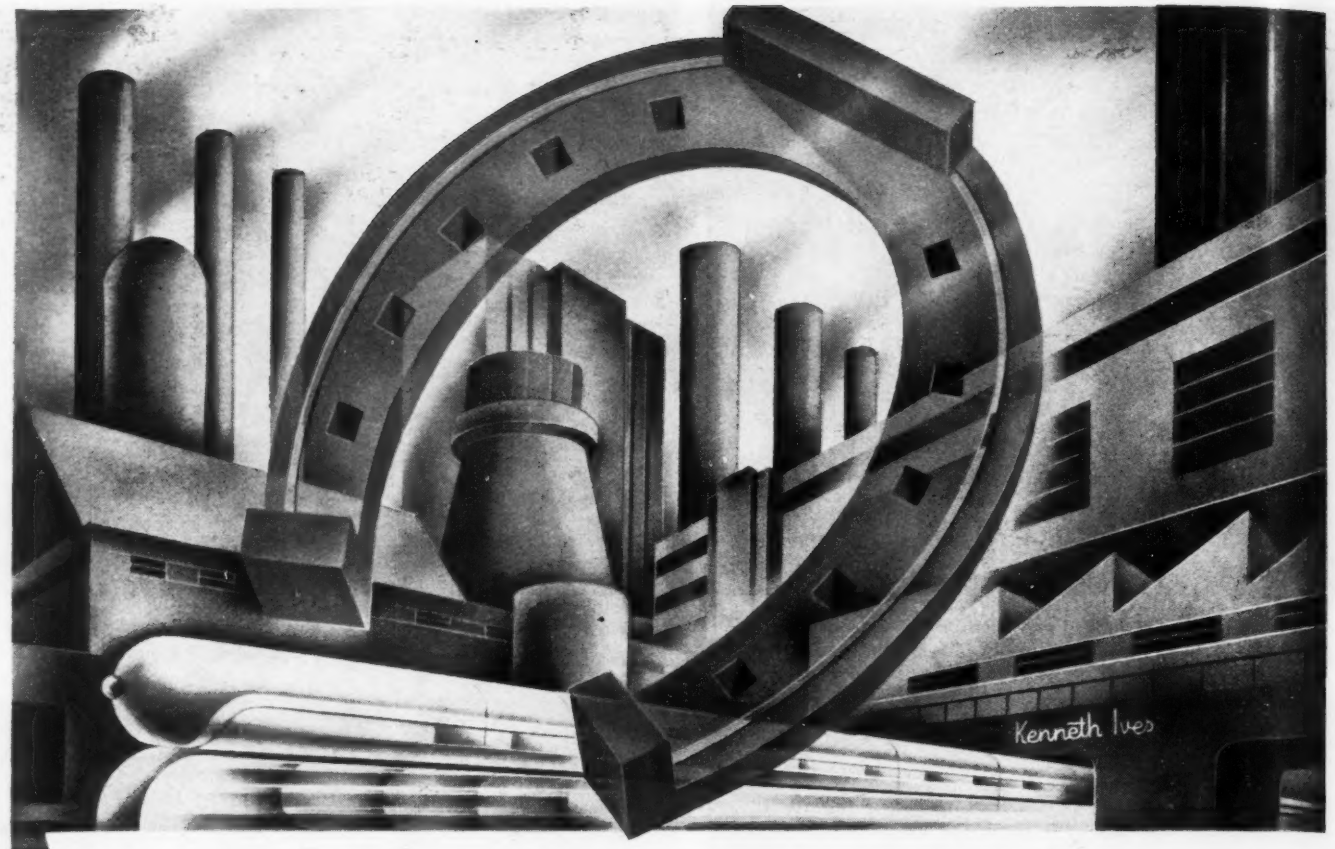


5 Reynolds huge "4-high" hot mill, rolls billets under tremendous pressure into long ribbons of gleaming aluminum alloy sheets.



6 First automatic stenciling machine in the Aluminum Industry, developed by Reynolds, permitting closely printed alloy, gauge and temper lines to insure precise identification.

9 Inspection of finished parts — blanked, formed, heat treated, anodized, zinc chromate primed, ready for aircraft assembly lines. *(No Scrap Problems)*



You Don't Know How Lucky You Are

... Lucky that medical directors, industrial nurses, and safety engineers are doing the fine job they are in keeping limited man-power effective and productive ... lucky that these far sighted executives developed the tools and techniques to fight occupational disease and accidents before war pressure made the need for them acute.

One such technique is a "Planned Procedure" featuring a new product designed to *combat* industrial dermatitis, not merely guard against it.

This new product, TARBONIS CREAM, has proved its effectiveness in ridding plant after plant of dermatitis due to cutting oils, chemical exposure, and some of the most difficult irritants in a dozen different industries. The proof is in its rapid acceptance by trained men in industry —the men who know.

An industrial physician and a progressive safety engineer in an Ohio ordnance plant, troubled with an average of 30 to 40 new cases of dermatitis a week, worked out a plan and procedure using TARBONIS CREAM. More than six months have passed, and not one case of occupational dermatitis has developed in that plant.

One of the world's largest plastics companies voluntarily wrote users of their irritating phenol-formaldehyde resins that a procedure using TARBONIS CREAM had proved the most effective method in twenty years of effort.

Here are examples of what medical directors, safety men, and first aid departments accomplish when they have the tools to work with, and the cooperation they must have to complete their vital work.

If occupational skin irritations are causing a problem in your plant, this "Planned Procedure" may solve it. Write for full details.

Listed below are a few, less than one per cent of the total number, of companies in one or more of whose plants TARBONIS CREAM is now at work.

THE TARBONIS COMPANY
1220 HURON ROAD • CLEVELAND, OHIO

ALUMINUM COMPANY OF AMERICA • BOHN ALUMINUM AND BRASS • CURTISS-WRIGHT • DOW MAGNESIUM • E. I. DuPONT DeNEMOURS • DUREZ PLASTICS AND CHEMICAL • GENERAL MOTORS JACK & HEINTZ • GLENN MARTIN • NASH-KELVINATOR • THOMPSON PRODUCTS • WAYNE-BENDIX

Tarbonis cream

FOR INDUSTRIAL SKIN IRRITATIONS

Cruise Control For Flying Efficiency

Part II . . . Effects of Atmospheric Conditions

By R. DIXON SPEAS, *Asst. to Vice-Pres., Engineering*
JERE T. FARAH, *Chief Flight Analyst and*
SANFORD HINTON, *Flight Analyst*
American Airlines

Detailed consideration of atmospheric variables, providing a basic understanding of problems influencing performance, further clarified by performance graphs.

FOUR VARIABLES of atmospheric conditions affect airplane and engine performance. These variables are:

1. Air pressure
2. Air temperature
3. Air density
4. Air humidity

One or more of these variables is involved in every item of performance and so must be considered directly in flight planning and flight operations. The manner in which items of performance are affected will be considered later, but for the present the variables themselves will be discussed.

Air pressure is, of course, a measure of the weight of air above any subject point, and it can be specified in pounds per square inch.

Air temperature is a measure of heat content of the air per unit volume and is measured in either of two scales, degrees Fahrenheit or degrees Centigrade.

Air density is a measure of air mass per unit volume. The units of air density are usually expressed in slugs per cubic foot. The unit slug is a mass unit and is determined by weight and value of g (32.17 ft./sec./sec.) acceleration of gravity.

$$\text{Slugs} = \frac{W}{g}$$

Air humidity represents the degree of moisture which is present in the air. This measure can be expressed as absolute humidity or relative humidity. Absolute humidity is the actual measurement of water vapor in the air and is expressed in units of weight per unit volume, such as pounds per cubic foot. Relative humidity is the ratio between the actual absolute humidity and maximum possible absolute humidity under the particular atmospheric condition. That is to say, if the absolute humidity is .0005 lb. per cu. ft. and the maximum amount of water vapor which can be held in the air under the existing conditions is .0010 lb. per cu. ft., then the relative humidity reading will be 50 percent.

The above units of measurement are as used in all general scientific work. Demands of aircraft performance studies, however, are such that new bases must be used for some of these factors.

In view of these demands air pressure is in feet above sea level. A pilot is interested in his distance above the ground, and the air pressure is one of the factors which is an indication of this. For instance, a pressure of 12.2

Table I — Engine Ratings and Limits
(Wright G102 Engine)

Rating	HP.	Engine RPM.	Manifold Pressure	Oil Temp. Deg. C.	Oil Pressure PSI.	Cylinder Temperature Deg. C. Max.	Mixture Fuel Air Ratio
Takeoff	1,100	2,350	43.0	105	50–65	230	.108–.112
METO	900	2,200	36.7	105	50–65	205	.108–.112
Cruising	625	1,950	(Use chart)	75	50–65	205	.070–.072

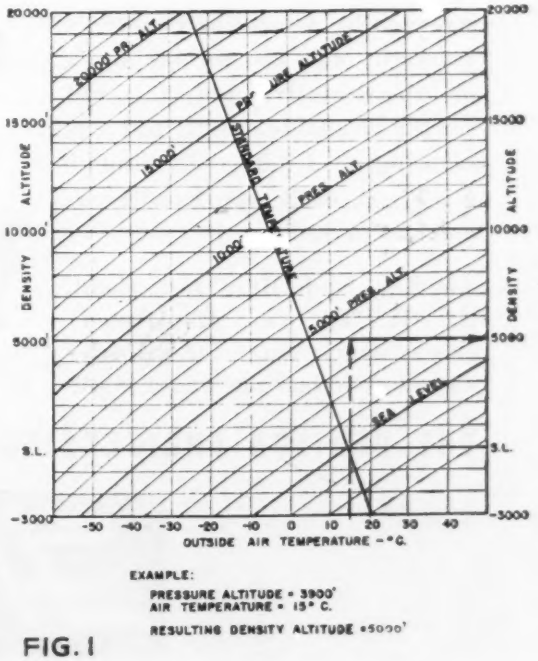


FIG. 1

GROUND WEAPONS for AIR COMBAT

DENISON HydrOILic AIRCRAFT TEST UNITS for *ground* tests of *flying* performance

They're trouble-shooters, these HydrOILic Test Stands. They spot flaws in the performance of aircraft parts and controls while ships and crews are safe on the ground.

The *flight performance* of elevators, ailerons, wing flaps, landing gear, rudders, bomb bay doors, propeller-feathering controls and other hydraulic hook-ups can be tested quickly and accurately by either of the two units shown here. The upper one is powered by an electric motor; the other, powered by a gasoline engine, is primarily for use on the field, or where electric power is not readily available. Both test circuits up to 1500 p.s.i. Similar models in each type handle circuits up to 3000 p.s.i.

Another HydrOILic test stand, the HSPT3 (not illustrated) checks spark plugs for pressure and electric leakage under simulated flight conditions. Another, the HPTS1, tests the feathering and unfeathering action of propellers. Still another, the AMTS1, tests magnetos under various conditions of altitude, humidity, temperature and speed.

HydrOILic Test Stand No. HTS3EM

HydrOILic Test Stand No. HTS4GE

Aircraft testing is only one of the many phases of Aviation in which HydrOILic Equipment is filling important needs. *Exactness* of control and *flexibility* of power—two of the major advantages of HydrOILics—are setting new standards of efficiency in production and materials-handling operations of many varieties, in almost every industry.

If you have a requirement or a problem that suggests the use of this smooth, versatile, *fluid power or power control*, take it up with Denison HydrOILic Engineers. If they don't already have the answer they will *plan* the answer, *design* the answer, *build* the answer. Write today!

THE DENISON ENGINEERING CO. 1166 DUBLIN RD. COLUMBUS 16, OHIO

DENISON EQUIPMENT in APPLIED HydrOILics

lb. per sq. in. is not as indicative to the pilot as is a pressure altitude of 5,000 ft. The faces of all practical altimeters have therefore been calibrated in feet of pressure altitude rather than pounds per square inch or any other unit of pressure measurement.

In order to establish the scales, a standard scale of air pressures against altitude has been agreed upon. Thus, an actual air pressure of 14.7 lb. per sq. in. came to be represented by 0 feet altitude or sea level, and a pressure of 12.2 lb. per sq. in. came to be represented by 5,000 ft. This scale has been established and adopted by the NACA to run from 4,000 ft. below sea level to 65,000 ft. above sea level.

Of course, this pressure altitude does not give the pilot a true indication of his actual altitude, because local air pressures can and do vary considerably from day to day. It does, however, give the pilot a basic unit of measurement upon which he can apply corrective adjustments in order to determine other basic conditions of the air which are important to him for performance reasons.

The pressure altitude basis has always been an accurate method of airplane separation. By having one pilot fly at a pressure altitude of 5,000 ft. and another pilot fly at a pressure altitude of 4,000 ft., etc., adequate altitude separation can be established.

Air temperature is always referred to directly in degrees Centigrade or degrees Fahrenheit for all performance specifications.

Air density is probably the most important atmospheric variable which is considered in matters of airplane and engine performance. The measurement unit established in this respect is feet of standard atmosphere. In order to establish this standard atmosphere, a scale of air temperatures has been assumed for correspondence with the scale of air pressures. Such assumption then provides an exact air density at each altitude of the combined scales. For example, at 5,000 ft. the standard temperature is 5 deg. C. and inasmuch as pressure and temperature directly determine density, the respective pressure of 12.2 lb. per sq. ft. thereby directly determines the density as .00205 slugs per cu.ft.

This same air density can, of course, be established by other combinations of pressure altitude and temperature. For example, reference to Fig. 1 shows that a temperature of 15 deg. C. and a pressure altitude of 3,900 ft. also establishes a density altitude of 5,000 ft. This basic density chart of Fig. 1 is incorporated in almost all charts of performance and is known as the standard atmospheric chart. Much use is made of this chart and so its basic foundation and function should be understood.

FIG. 2 RELATION OF SPEED & POWER 5000 FT., 25,200 LBS. GR. WT

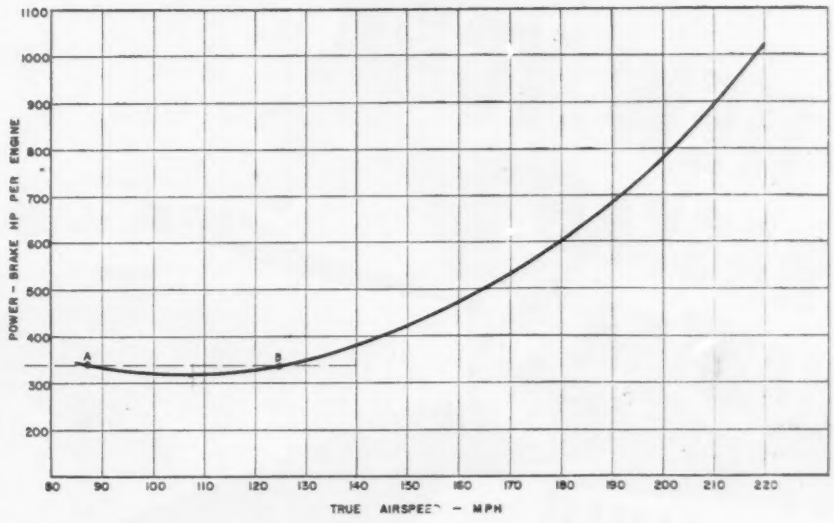


FIG. 3 VARIATION OF PROPULSIVE EFFICIENCY WITH ENGINE SPEED

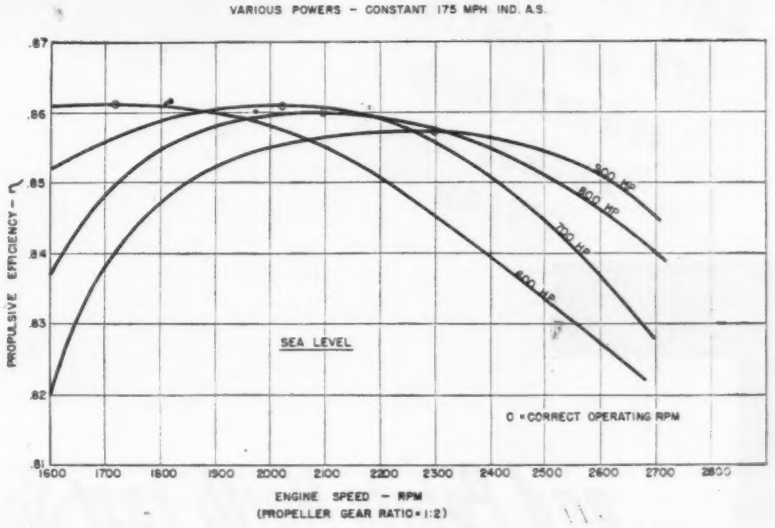
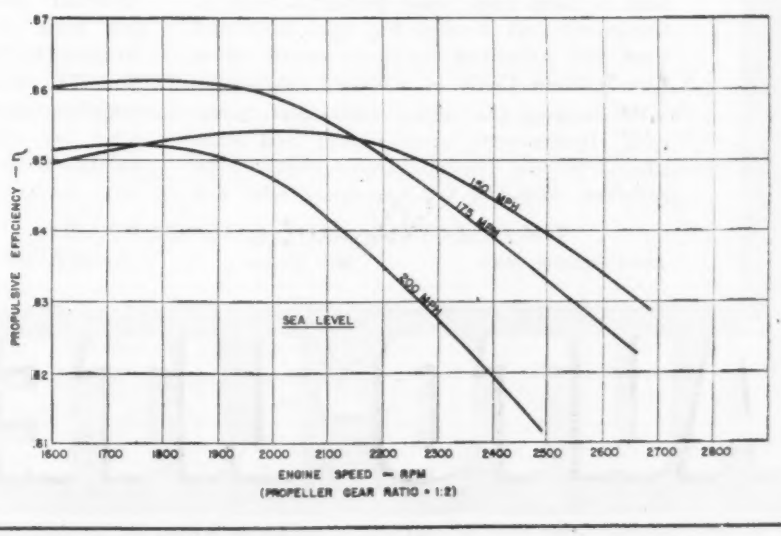


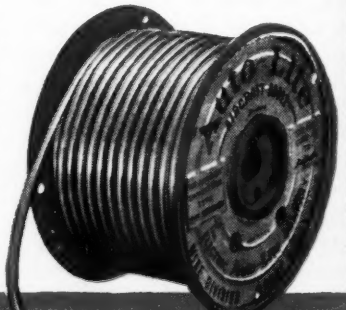
FIG. 4 VARIATION OF PROPULSIVE EFFICIENCY WITH ENGINE SPEED



... and Points North·East·South and West

Blazing air trails all over the world, Pan American Clippers . . . intrepid "Merchant Marine of the Air" . . . have become an integral part of the United Nations' war effort. And to help keep those powerful 4-engine transports aloft through fog, rain, snow and sleet, Pan American engineers specify Auto-Lite Ignition Cable as standard equipment.

For landing gear lights, radio and "intercom," instruments, guns, pumps and other phases of low tension circuit required by aviation, Auto-Lite also produces wire and cable that meet the standards of Army-Navy Specification AN-JC-48. Greatly increased resistance to abrasion and appreciably longer life is definitely assured with Auto-Lite's new "B-Braid" covering and "CA" lacquer. Our Form No. 838 contains complete information on these points. Write for your copy today.



THE ELECTRIC AUTO-LITE COMPANY

PORT HURON, MICH. *Wire Division* SARNIA, ONTARIO

AUTO-LITE AIRCRAFT WIRE and CABLE

IN ITS 26 GREAT MANUFACTURING DIVISIONS, AUTO-LITE IS PRODUCING A LONG LIST OF ITEMS FOR AMERICA'S ARMED FORCES ON LAND, SEA AND IN THE AIR

Air humidity is not considered of basic importance in most items of airplane performance. In normal flight planning and flight operation, no consideration is given to air humidity, and it is only in the more exacting scientific flight researches that the air humidity must be established. Such tests consider air humidity according to the respective requirements of engineering aspects.

The speed-power curve of Fig. 2 is a basic presentation for all airplane speed performance data. This curve indicates how the speed will vary according to power—not directly or even as the cube root of the power, but rather as a variable relation according to the speed range being considered. At slower speeds a small increase in power causes a relatively high increase in speed, while in the higher speed range a larger increase in power is required for the same increase in speed. The usually assumed cubic relation between speed and power is a reasonable approximation, however, for small increments in the normal cruising range.

An interesting characteristic of the speed-power curve is the "hook" in the low speed range. This "hook" explains a speed-power phenomenon sometimes reported by pilots of certain airplanes during flight at low airspeeds, who report that when they climb to cruising altitude and start to cruise at a relatively low power, the airplane appears to drag along in a tail low position. If, however, they climb above their normal cruising altitude, then dive down to this altitude and reduce power to the same relatively low power as before, the airplane will fly in a more natural attitude and will fly at a faster speed.

From Fig. 2, for instance, we can see by the example that 340 hp. under conditions of the chart gives airplane speeds of both 87 and 124 mph. In order to fly at the higher speed, the pilot must establish a relatively tail-high position of the airplane (low angle of attack). The method of climbing above cruising altitude and then diving is quite effective in accomplishing this tail-high position, although subsequent air gust conditions may return the airplane to its slower speed condition and a climb-dive procedure must be repeated. The same result can be obtained, of course, by increasing the power with an attendant increase in cruising speed, then decreasing the power to the desired cruising condition.

Operation limits are specified for each engine in the form of power ratings. These limits have been established on the basis of reliability of operation. The limits do not, however, represent absolute specification, in that under emergency conditions the limits may and have been exceeded. Engines have been

(*Turn to page* 305)

FIG. 5 VARIATION OF PROPULSIVE EFFICIENCY WITH ENGINE SPEED

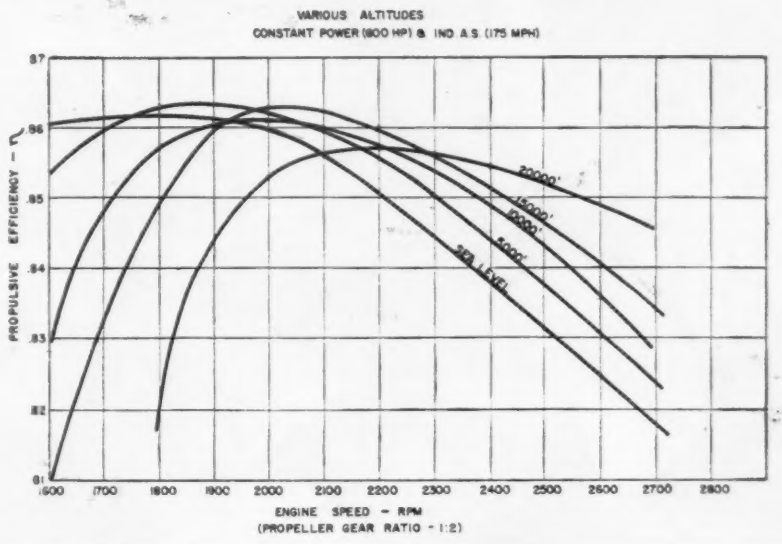


FIG. 6 VARIATION OF SPECIFIC FUEL CONSUMPTION WITH ENGINE SPEED

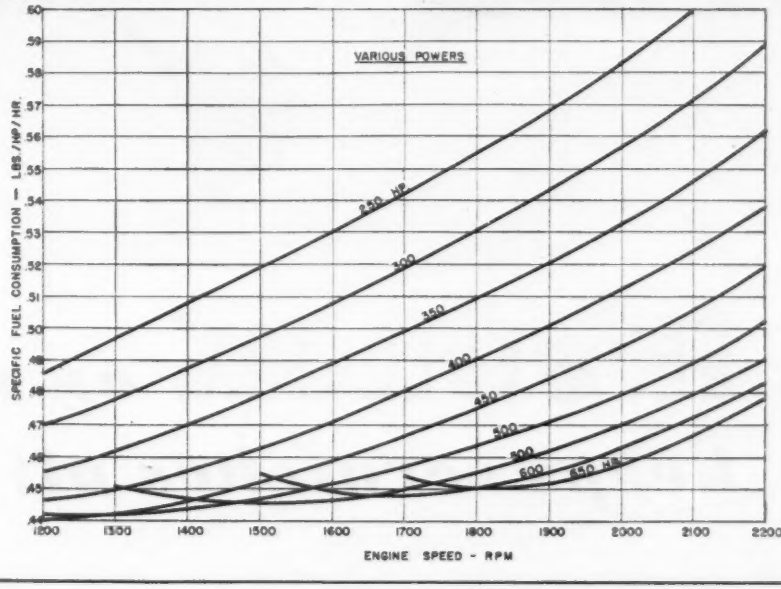
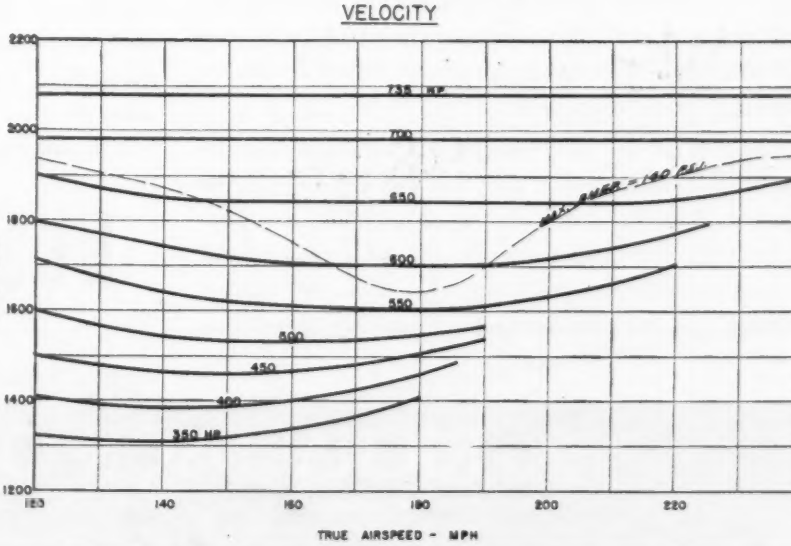
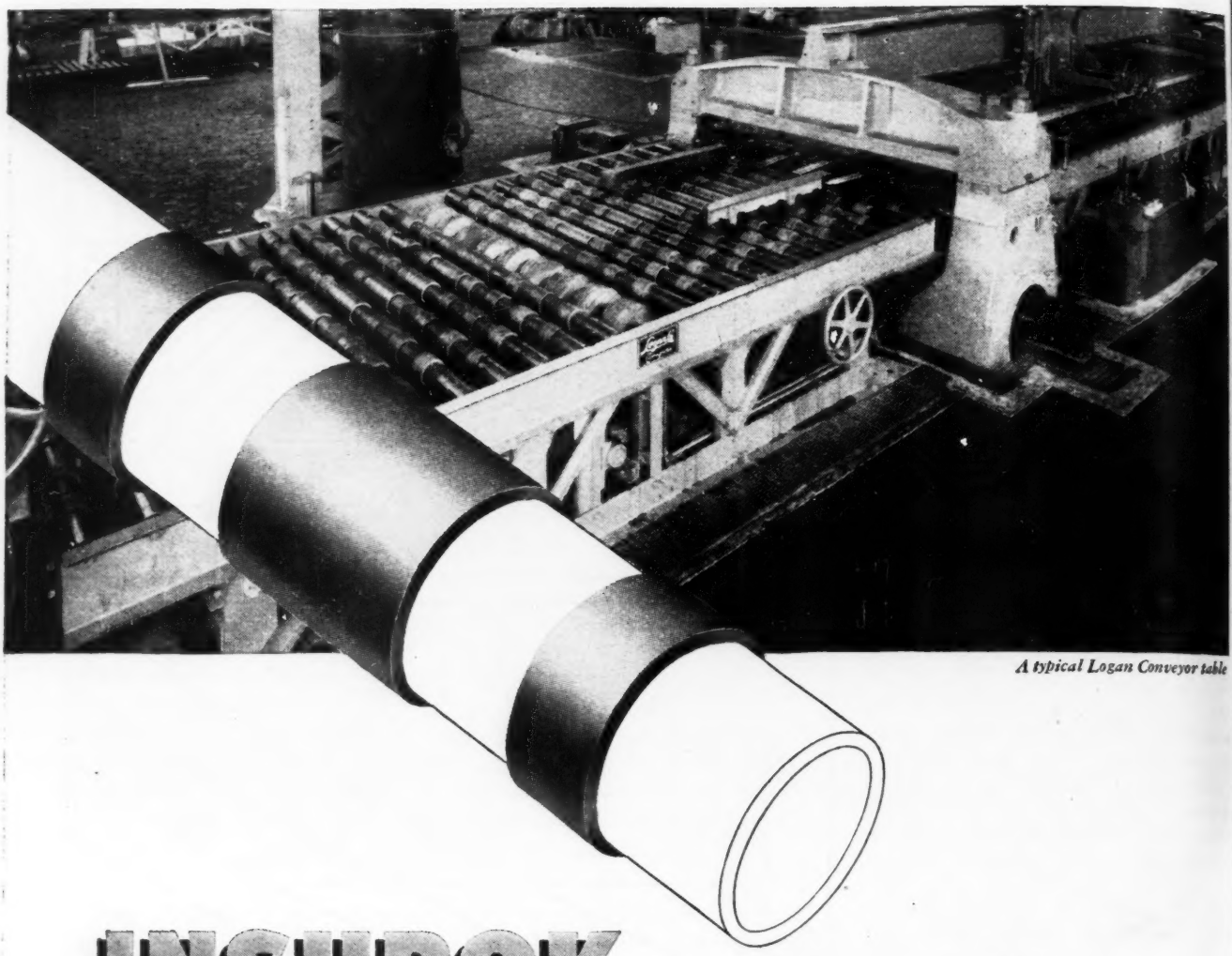


FIG. 7 R.P.M. FOR BEST $\eta_V/_C$ VS. VELOCITY





A typical Logan Conveyor table

INSUROK *on the rolls keeps scratches off the sheets*

Stainless steel and aluminum sheets, which are today almost worth their weight in gold, start their trip to fabricators over roller conveyors like this. Protecting the sheets from mars or scratches are sections of INSUROK affixed to the rolls. This is but one of the many ways in which Laminated INSUROK was used to solve problems before the war—is helping to solve them now.

In addition to the many spectacular wartime uses to which INSUROK, molded and laminated, has been put by the armed forces, it is widely used for many commonplace articles—things that you see and use every day. For scores of products for the home, the office, the factory, INSUROK can effect numerous manufacturing economies, can do things which could not heretofore be done, can solve many a postwar problem effectively and economically.

Richardson Plasticians can help you select the grade of Molded or Laminated INSUROK best suited for any mechanical, electrical or chemical applications. They will be glad to suggest the commercial or special grade to meet all the conditions under which your present or postwar product will perform. Write for complete information.

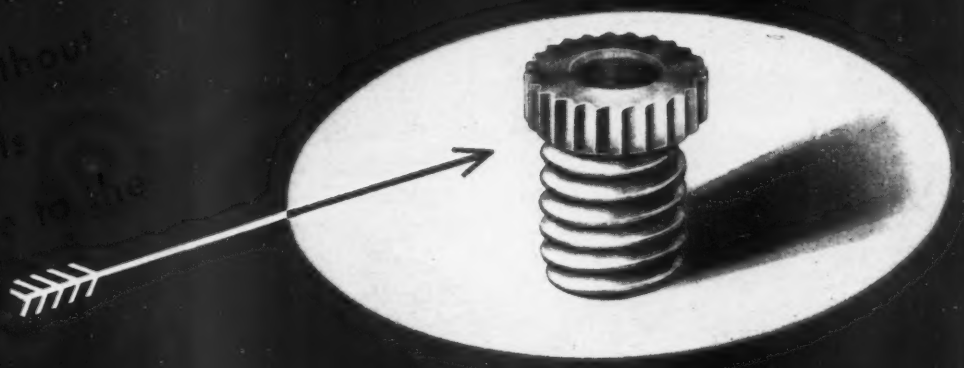
INSUROK

Precision Plastics

The RICHARDSON COMPANY

MELROSE PARK (CHICAGO) ILL. NEW BRUNSWICK, N. J. FOUNDED 1868 INDIANAPOLIS, IND. LOCKLAND (CINCINNATI) OHIO
DETROIT OFFICE: 4-252 G. M. BUILDING. PHONE MADISON 9386 NEW YORK OFFICE: 75 WEST STREET. PHONE WHITEHALL 4-4487

NOW IT CAN BE DONE!



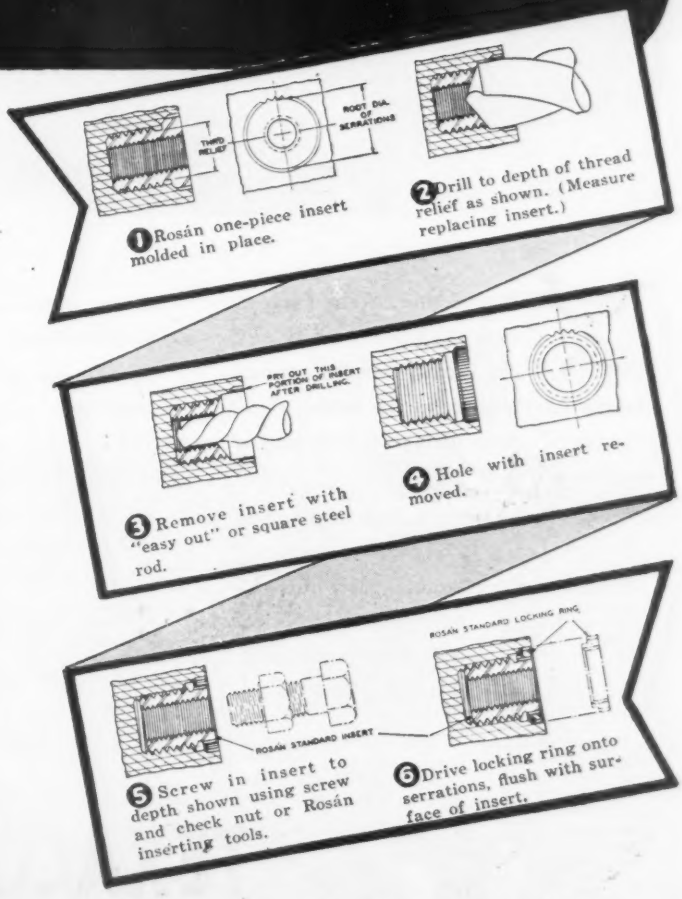
Patents Pending

The Rosán One-Piece Molded-in Insert not only may be removed without disturbing the parent material, but it leaves a threaded, counterbored and serrated hole into which a standard Rosán Threaded Insert may be screwed and locked by the regular process of the Rosán Locking System.

The principle of the Rosán Locking System, which furnishes this solution to fastening problems, is very simple and ingenious. On the standard Rosán Insert, there is a serrated collar. The Rosán Locking Ring, which is serrated both inside and out, engages its inner teeth with the serrations on the collar while its outer teeth, or splines, broach their way into the parent material at the wall of the counterbore. The pressure of the surrounding material causes the Locking Ring to close in upon the collar enough to eliminate all tolerance and make a permanent, solid installation. The diagrams at the right show the method of removing the Rosán One-Piece Molded-in Insert and replacing it with a Rosán standard unit.

There is also the Rosán Molded-in Stud which is locked in the material, but replaceable like the Insert.

Manufacturers are invited to submit their fastening problems to our Engineering Department. No obligation. Write for full information and descriptive literature.


THIRD RELIEF
ROOT DIA. OF SERRATIONS
PRY OUT THIS PORTION OF INSERT AFTER DRILLING
ROSÁN STANDARD LOCKING RING
ROSÁN STANDARD INSERT

1 Rosán one-piece insert molded in place.

2 Drill to depth of thread relief as shown. (Measure replacing insert.)

3 Remove insert with "easy out" or square steel rod.

4 Hole with insert removed.

5 Screw in insert to depth shown using screw and check nut or Rosán inserting tools.

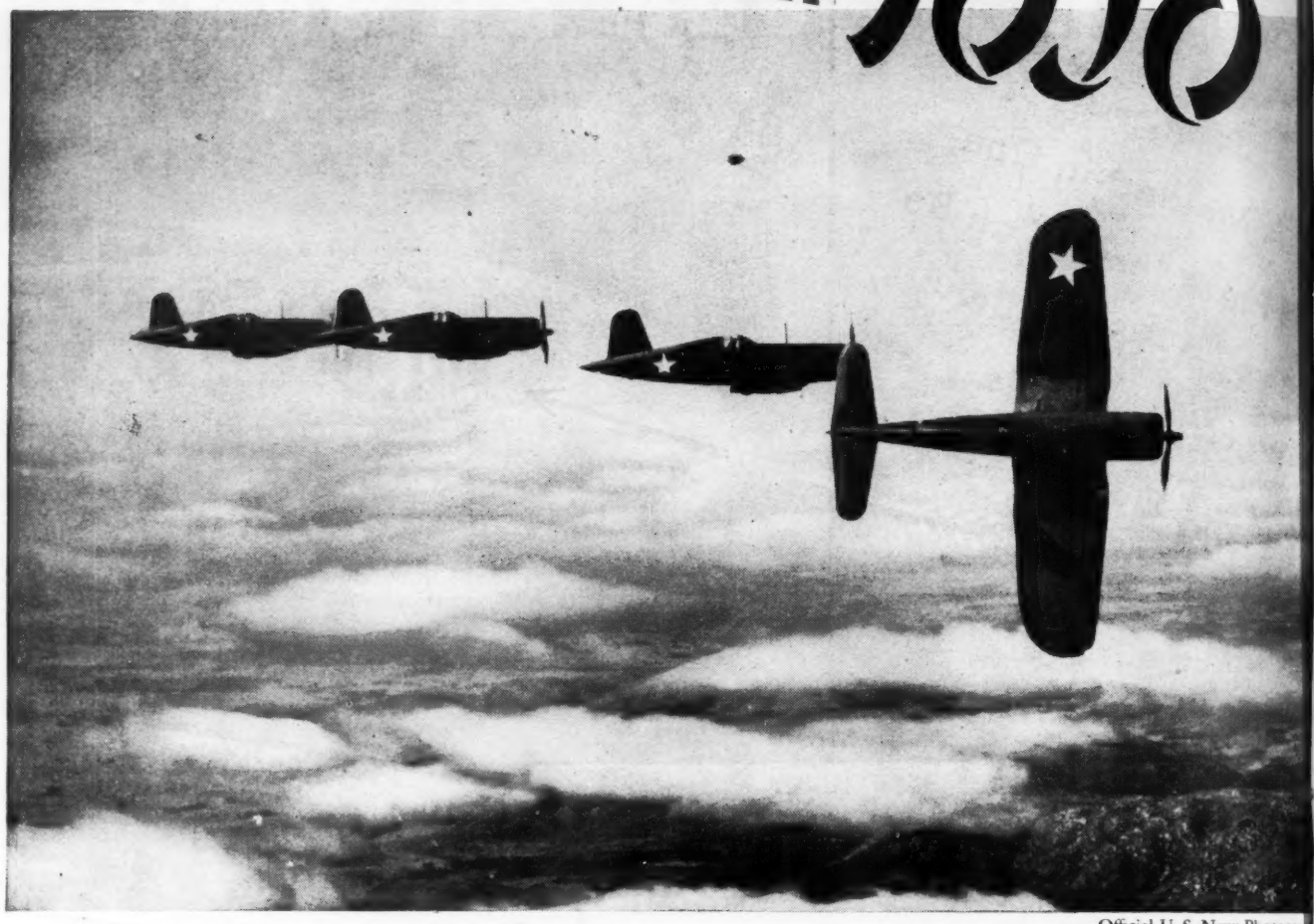
6 Drive locking ring onto serrations, flush with surface of insert.

THE ROSÁN LOCKING SYSTEM

BARDWELL & McALISTER, INC.

7630 Santa Monica Boulevard, Hollywood 28, California

MORE TROUBLE FOR Tojo



Official U. S. Navy Photogra

Rated one of the fastest, and equipped with one of the most powerful engines in any navy fighter in the world, these "Corsairs" are models of superb engine performance.

Not only Corsairs, but thousands of other Army, Navy and commercial planes are giving reliable, economical performance . . . lubricated and fueled with *Texaco Aircraft Engine Oil* and *Texaco Aviation Gasoline.* In fact . . .

More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

So effective have Texaco lubricants proved that they are definitely preferred in many other important fields, a few of which are listed in the panel.

A Texaco Aviation Engineer will gladly cooperate in the selection of Texaco Aviation Products, available at leading airports in the 48 States. Phone the nearest Texaco distributing point, or write The Texas Company, *Aviation Division,* 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated and fueled with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

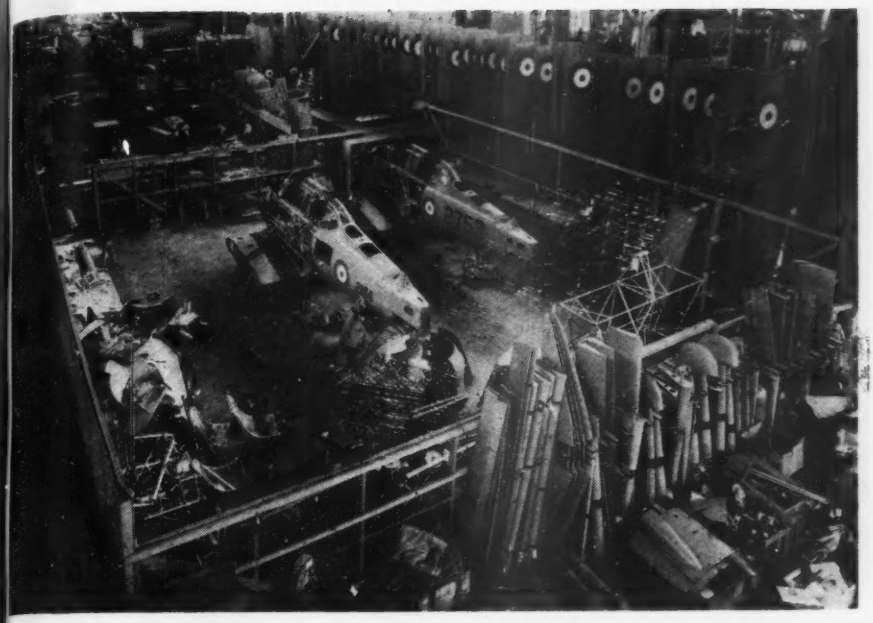
★ More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.

TEXACO

TEXACO Lubricants and Fuels

FOR THE AVIATION INDUSTRY

TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT – CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY



Tear-down crib in the Noorduyn repair plant, where *Harvard* trainers and *Norseman* transports are disassembled to the last piece for inspection and repair. As in this country, engines and instruments are sent out to manufacturers or their agents. Radio is overhauled in the shop.

MAINTENANCE

New Planes for Old

Production machinery and line assembly answer repair problem on "Harvard" trainers and "Norseman" transports produced and rebuilt at Noorduyn plant in Canada.

NOORDUYN'S airframe repair plant is one of the foremost examples of Canada's efficient wartime expansion in the aviation industry. Realizing early in the game the desirability of being service agent to its own products—the AT-16 *Harvard* and the *Norseman*—Noorduyn Aviation, Ltd., is the only producer of aircraft in Canada that handles all major repair of its own designs and manufacture.

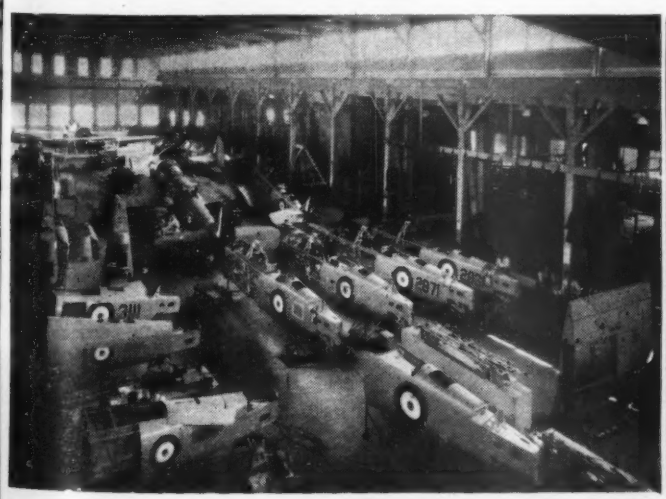
Advantages are threefold. First, planes to be repaired are put in the hands of the men who have built them; second, tooling and machinery required are similar to those of the production line; third, replacement of non-repairable parts can be done from production on the spot.

Since casualties run higher on training planes than on other types, the repair plant is geared to handle a number of these planes in fairly high ratio to those produced. Although *Norseman* transports are also repaired here, this work does not run in sufficient volume to warrant complete production line machinery. Repair is largely done as hand work, with whatever new parts required supplied from production. Hence, the line described here is devoted almost entirely to the trainers.

The plant is laid out like a production line. Damaged craft sent in from various training schools and depots arrive at one end of the building for preliminary breakdown into major components. Engines are removed, crated, and sent to the manufacturer or nearest overhaul agent. Instruments, with exception of radio equipment, are treated likewise. The airframe itself is disassembled into major parts.

The wing section occupies nearly one whole side of the building. Following disassembly and inspection, wings are rebuilt in accurate steel jigs as in the production line. There is a fabric de-

(*Turn to page* 309)



Assembly portion of plant. Repaired units feed in from both sides as fuselage progresses down line. A Bristol *Bolingbroke* has temporarily interrupted the flow of *Harvards*.

This is the way a crashed trainer often looks when it arrives on a flat car in winter. Several hours thawing is necessary before work can be started.

Tire Installation Dolly

Designed and built by the plant engineering department of Consolidated Vultee, this wheel and tire dolly was originally intended for use in assembly line installations on B-24's and C-87's, but it has been found very well adapted to field service work. One man can handle this 550 lb. load where four were formerly required. After jacking up the airplane to be serviced, dolly is pushed up to tire and the tongue is engaged in wheel slot. Pressure on the lever does the rest. When the wheel is free from its axle, lever is pushed further down and locked by a pin through the frame, as shown. Handle slips out and fits into carrying sockets to make the unit compact. Note padded block for a bearing point on wheel.

MAINTENANCE

The dolly itself weighs only 45 lb. It is constructed of welded steel tube, and the engaging tongue is of 3/8 in. heat-treated chrome moly. With this device, one man can replace several men —can handle a wheel with less danger of injury to himself and the tire than formerly.

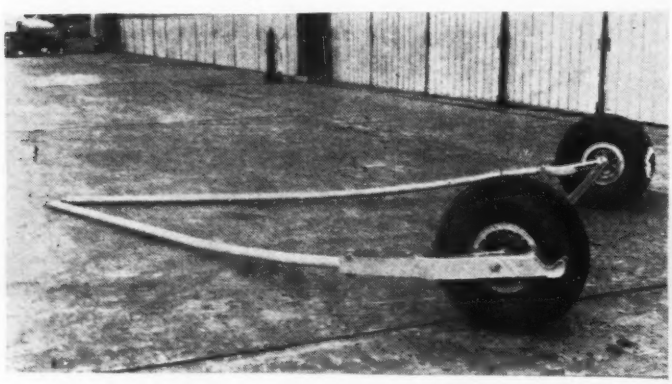
Some Cues On Care of Rubber

According to Ted Gibson, assistant superintendent of maintenance at Braniff Airways, Dallas, conservation of rubber tires is a matter of correct inflation, cleanliness, and common sense.

Planes standing any length of time for overhaul and inspection should have the tires covered by canvas to prevent oil drip on the rubber. Similarly, care should be taken to keep hangar floors and aprons free from oil accumulation. Tests conducted at Braniff have shown that tires last longer and give just as good service when inflated to 40 lb. instead of the 28 which was customary until a few years ago. Pressure is checked every 25 hr., and valve stems are carefully cleaned. The latter is important because dirt in a valve spring can cause a slow leak which will deflate the tire between inspections. After 25 hr. of use, tires are washed with soap and water to remove possible deteriorating agents.

Spare Tire Tow Bar

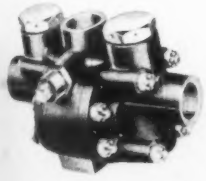
To remove a plane with a flat tire from a runway in a hurry, or merely to take the plane where tire change will be easier, this towing device has been built by No. 2 Air Observer School in Canada. Extensions on the shafts hook under landing gear axles, and when shafts are brought down weight of the airplane is taken on towing wheels, saving the tire from further damage. A tractor hooked onto the yoke does the rest. Note metal covers (behind propellers) over reduction gear boxes to prevent oil from congealing in the propeller blast at low temperatures.



PESCO

PERFORMANCE CONTROLS THE AIR

Curtiss Helldiver



PESCO Flow Divider for equalizing hydraulic pressure.

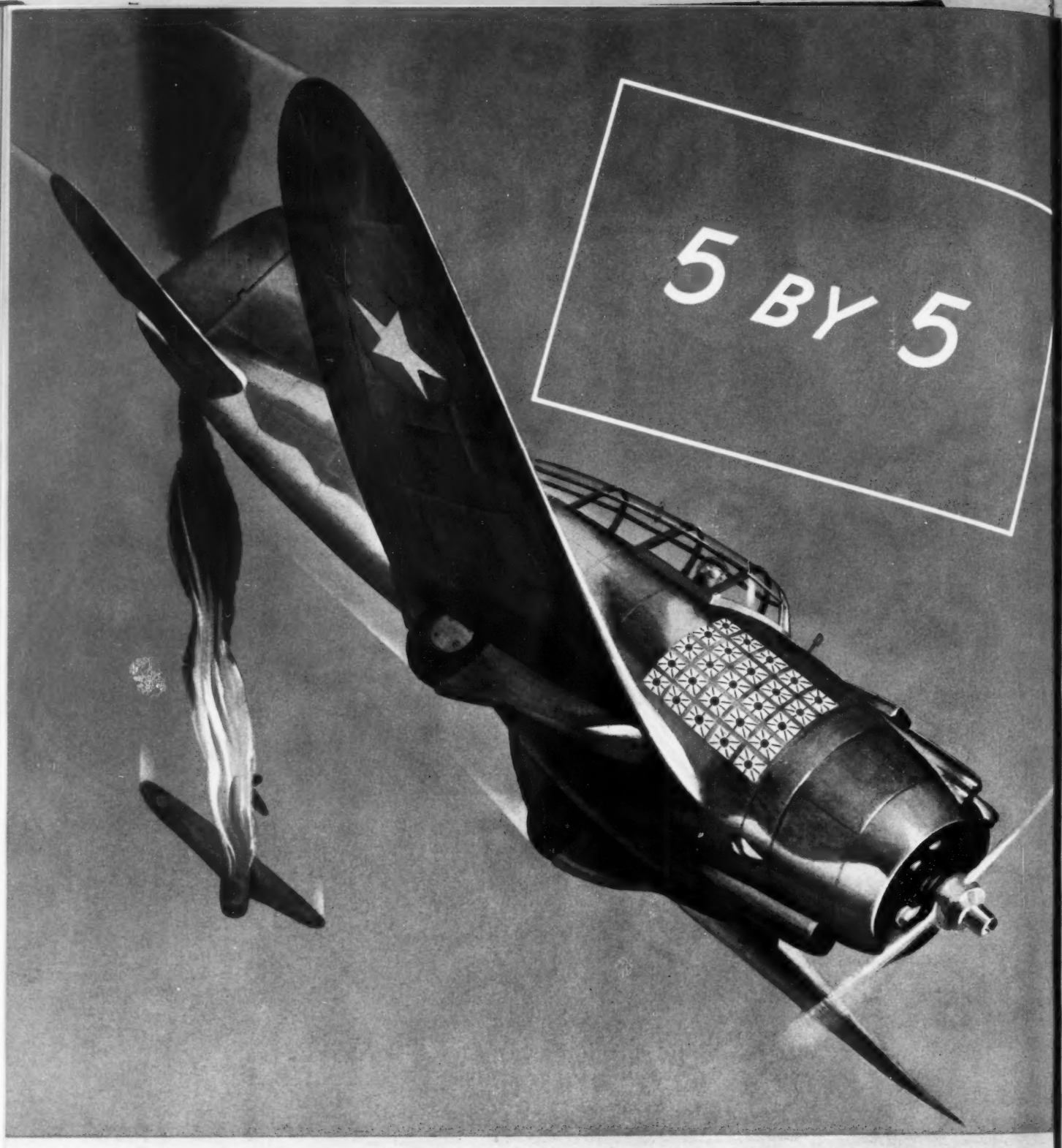
Down they go! Straight down. Peeling off one after another; fingers eager to blast another symbol of hate to the bottom of the sea. With never a thought for themselves, these brave sons of ours pray only that their aim be true . . . that the performance of each plane part be faultless. Here is where the precision of the men who make our planes, and the men who fly them, become a combination that can't be beat!

ARMY E NAVY

In Aircraft Hydraulics, Fuel Pumps, Air Pumps, Related Accessories . . .

PERFORMANCE POINTS TO Pesco FIRST

DIVISION BORG-WARNER, CLEVELAND, OHIO



Tomorrow another Jap flag will appear on the side of this fighter—a symbol of the marksmanship of American Aces who are relentlessly and systematically clearing the skies of every zero that dares to come within range of their deadly leaden sting.

AIRCHOX COMPANY, Division of

JOYCE AVIATION, INC.

And on every front American-made equipment is showing its superiority over the labels "Made in Japan" and "Made in Germany." In this conflict of men and machines, the combination of American ingenuity and courage cannot be whipped.

General Offices, 8 S. Michigan Ave., Chicago

WORLD'S LEADING MANUFACTURERS OF AERONAUTICAL SAFETY EQUIPMENT

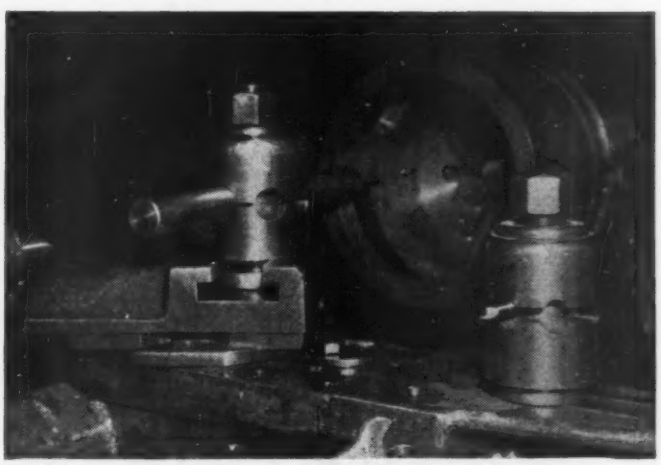
AVIATION'S MAINTENANCE NOTEBOOK

Device Used by PAA To Test Plane Fabric

• To avoid guesswork in determining condition of fabric on control surfaces, Pan American inspectors are using this Mullen standard paper tester, which operates with hydraulic pressure exerted on a rubber diaphragm, forcing the fabric sample up inside clamping ring which holds it in place. Pressure (as indicated on dial) at which the dope covering on fabric first begins to crack is noted first. This shows how adherent and flexible the preparation is. Pressure at which fabric actually bursts gives its true condition. Bursting standards can be set up only in relation to type of fabric and dope used and according to the number of coats. This machine has shown that, contrary to general belief, oil on fabric does not weaken it, rather keeps it more flexible.

Bent Light on Chicago & Southern Instrument Panels

• Lighting of this instrument panel was bad due to inequality between general indirect lighting of panel and individual lighting of directional gyro throughout rheostat control range. Trouble was difference in resistance between the two. Putting to use the light bending properties of Lucite, Chicago & Southern fastened two Lucite strips (as shown) with ends backed to light bulbs and tips pointed in on dial. Since light for gyro was now received from same source as that serving the rest of the board, equalization of illumination was obtained throughout range of the rheostat. It will be noted that this flight instrument panel is the same quick change unit, developed by Chicago and Southern, as was illustrated in Aviation's Maintenance Notebook for July.



TCA Boring Bar Holder for Lathe

• From Trans-Canada Air Lines' machine shop in Winnipeg comes this boring bar holder for lathe. Made of an old locomotive piston, it consists of a center piece flanged at bottom for attachment to lathe and threaded at top for tightening down. The center piece is bored to take the largest size bar accommodated by outside holes. The outside pieces move about center piece and are provided with a range of several hole sizes. Any bar selected is put through center piece, and the outside pieces are revolved until proper fit is obtained. Holder is then inserted in lathe and tightened in place. Bar is held at points of most favorable leverage on outside of circle circumference. Also permitted is rapid change of boring bar without removing holder. Designer was C. H. Wilson.

The War...And You!

Friend—don't think this war doesn't affect you. It does. It's pushing the world twenty years ahead of time; stimulating the development of devices you may now be making or using. After the war, the average American's life is destined to be fuller, more exciting, more comfortable due to these new products. And just as Weatherhead has helped build the nation's automobiles, airplanes and refrigerators in the past, peace will find us prepared to join you in building these established products as well as the many new ones certain to come out of the war.

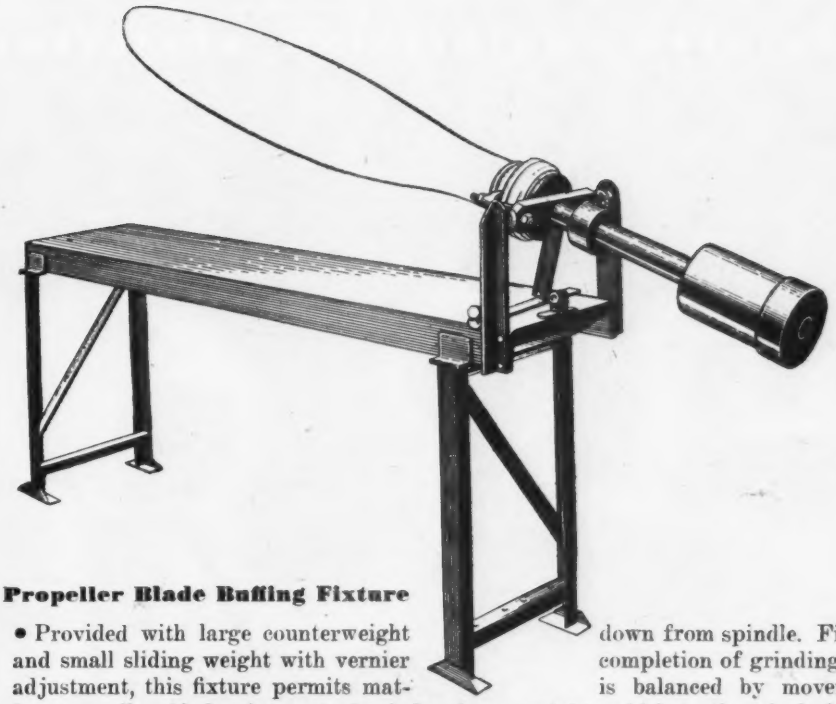
Look Ahead with

Weatherhead

THE WEATHERHEAD COMPANY, CLEVELAND, OHIO

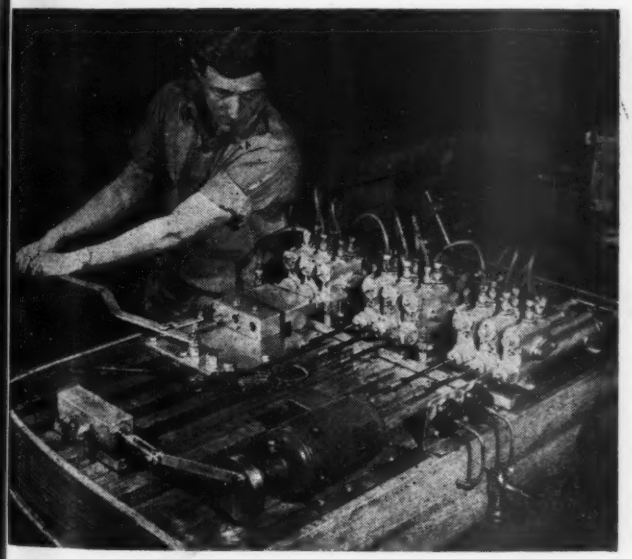
Manufacturers of vital parts for the automotive, aviation, refrigeration and other key industries.

Plants: Cleveland, Columbia City, Ind., Los Angeles
Canada—St. Thomas, Ontario



C & S Propeller Blade Buffing Fixture

• Provided with large counterweight and small sliding weight with vernier adjustment, this fixture permits mating propeller blades into sets by balancing against a weight adjustment. When a set of blades is ready for overhaul, blade having worst nicks and surface condition is selected and placed on spindle for grinding and polishing. For this work, spindle is locked by a pin through clevis on table top, hole of which aligns with hole in arm extending down from spindle. First blade, after completion of grinding and polishing, is balanced by movement of small weight, which is then locked in place by a thumb screw. Second blade is installed, ground, and dressed until it balances against weight setting of first blade. Same procedure is followed for third blade. Chicago & Southern has found that this procedure considerably speeds final static balance of propeller assembly.



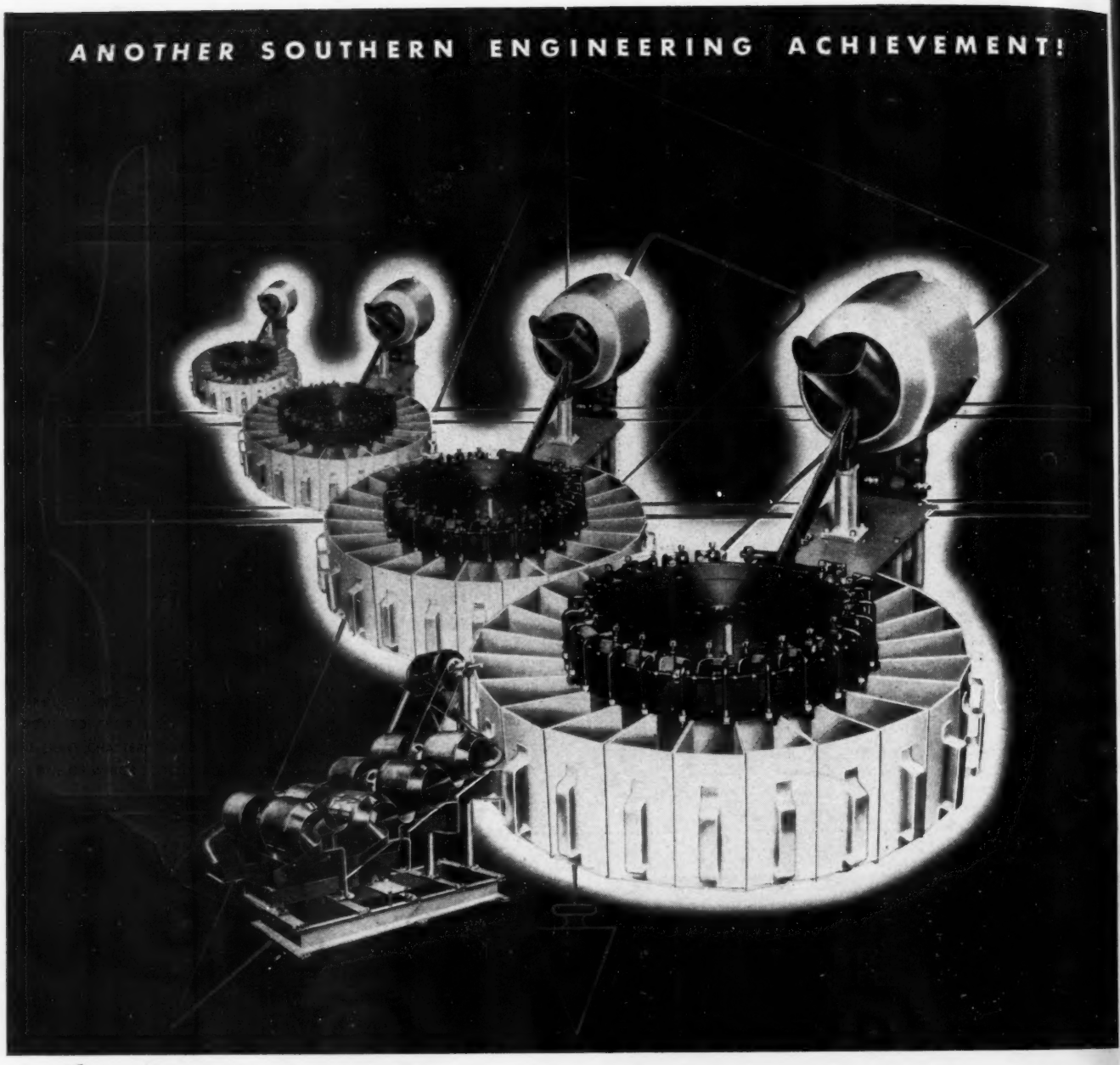
Servo Unit Test Table at AA

• For testing and running-in servo control units, American Airlines' instrument shop has built this bench with a fluid tank and pump below. Small motor on top runs at slow speed and moves valve which changes direction of fluid flow when breaking-in units, which are run until they move at a tension of 5 lb. as tested by hand scales attached to rods. Relief valves are tested by hand (as illustrated) with pressure checked on meters, which also record operating pressures when units are being run. Additional units can be handled simultaneously.

PAA Rivet Bucker

• For the difficult job of bucking rivets inside a torque tube, Pan American's New York metal shop has developed this bucking bar. It is made of two heavy pieces of steel with a spring set in one half and with the other half fastened against the spring by nuts but free to move in and out on the four securing bolts. When compressed and pushed inside a tube, rivet gun sets up responsive vibration in the bar which heads home the rivets. Handle is detachable by unscrewing from block, and any length can be used.

ANOTHER SOUTHERN ENGINEERING ACHIEVEMENT!



New unit sorts rivets faster AT TREMENDOUS SAVINGS IN MAN-HOURS AND DOLLARS!

Southern Engineering's Rivet Sorter #101-Model B makes obsolete all previous rivet sorting methods and conceptions.

At an approximate cost of 15 cents per pound (including investment, operation and depreciation), its operation represents remarkable savings in man-hours and costs.

It speeds salvaging by efficiently sorting from 50 to 60 pounds of rivets per hour.

It conserves vital materials by salvaging rivets which would otherwise be replaced by new materials with additional manufacturing time and effort.

It saves dollars and time by salvaging rivets formerly destined for re-melting and re-fabrication

Its operation within a reasonable period of time should represent savings substantial enough to avoid a capital investment holdover in the event hostilities cease.

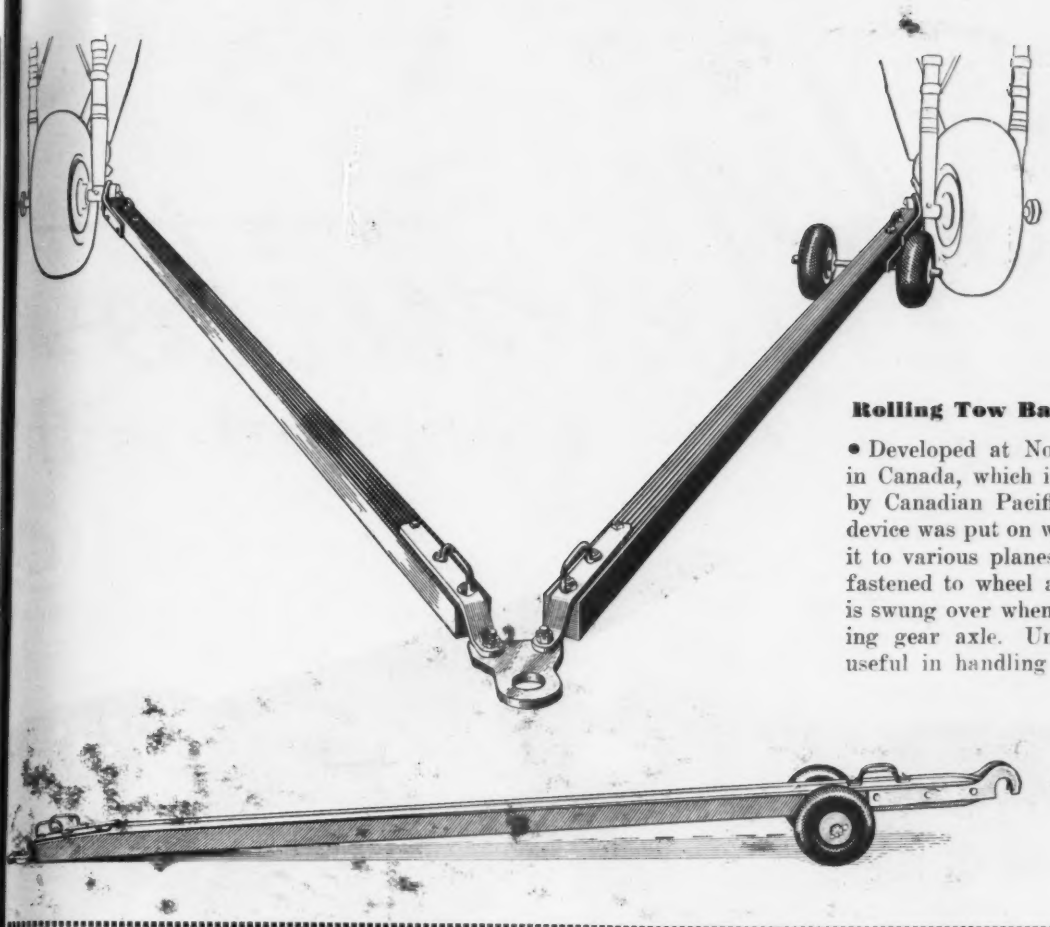
This unit sorts by lengths and shank diameters from 3/32" to 3/16" in increments of 1/32", 3/16" to 1/2" in length; in increments of 1/16" in lengths of 1/2" to 1-1/2". It handles countersunk, brazier, flat and round head rivets. (Your present operation sorts by materials, i.e. magnesium, steel, Dural, etc.) #101-Model B consists of two sections: The Screening Section sorts by shank diameters, and the ingenious Disc Sorter Section selects certain type heads and all rivets by length.

Write today for a quotation covering your requirements.

SOUTHERN ENGINEERING CO., INCORPORATED

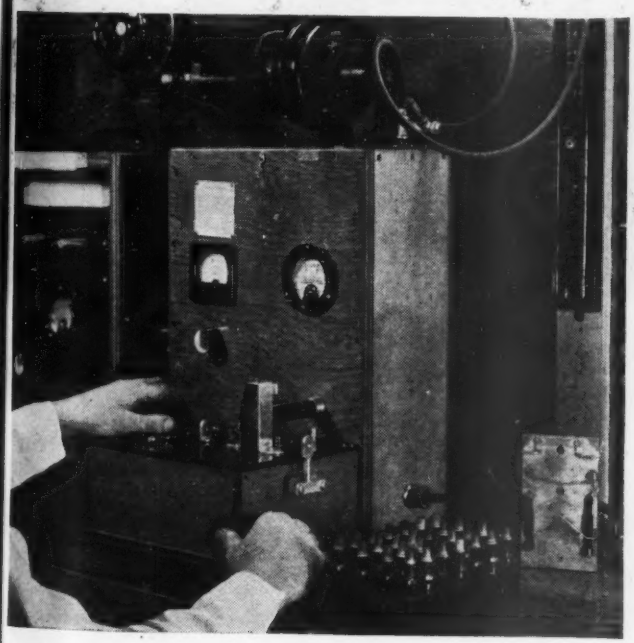
816 West Fifth Street **Los Angeles 13, California**

SEC



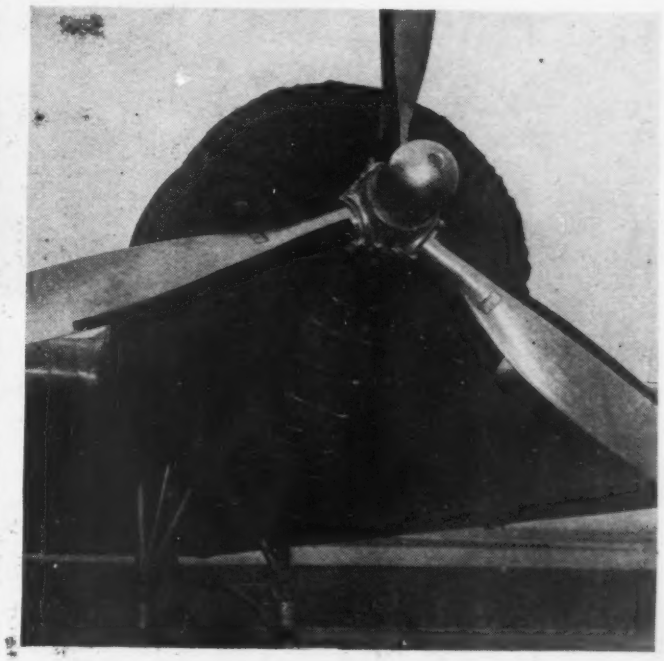
Rolling Tow Bar

• Developed at No. 2 Air Observer School in Canada, which is run for the government by Canadian Pacific Air Lines, this towing device was put on wheels to facilitate hauling it to various planes to be towed. One leg is fastened to wheel axle; other rides free and is swung over when hooked onto plane landing gear axle. Unit has been found very useful in handling twin-engine trainers.



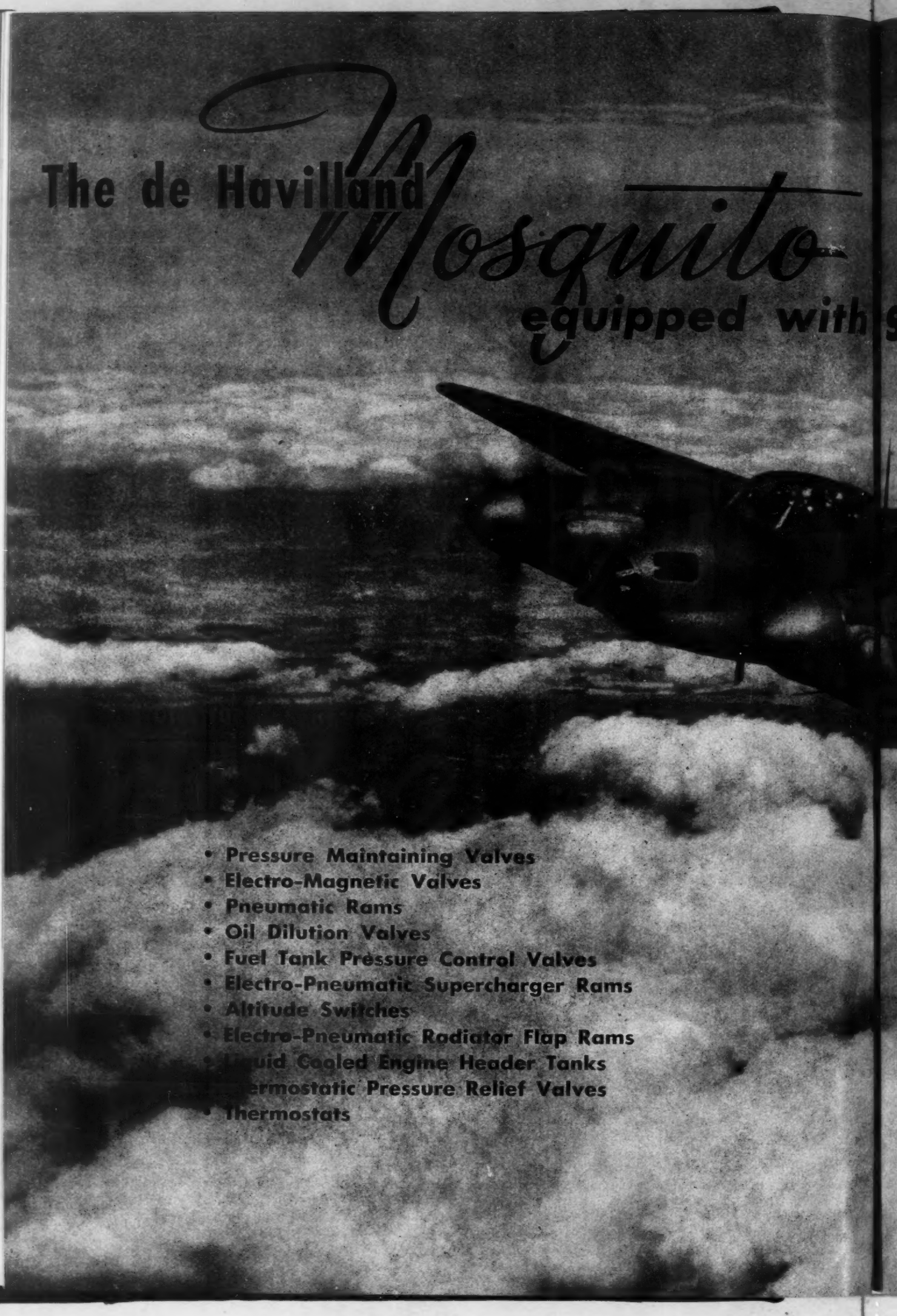
UAL Spark Plug Core Tester

• As a rapid means of sorting out faulty spark plugs before assembly, United developed this dielectric tester, which is fed by a 110-v. a.c. 60-cycle current through a Variac auto transformer, giving operator a testing range of 0 to 10,000 v. For standard spark plug cores, dielectric standard is 100 megohms at 6,500 v. Meter on left of panel indicates primary voltage applied to transformer. Meter on right indicates leakage through plug core in tenths of milliamperes.

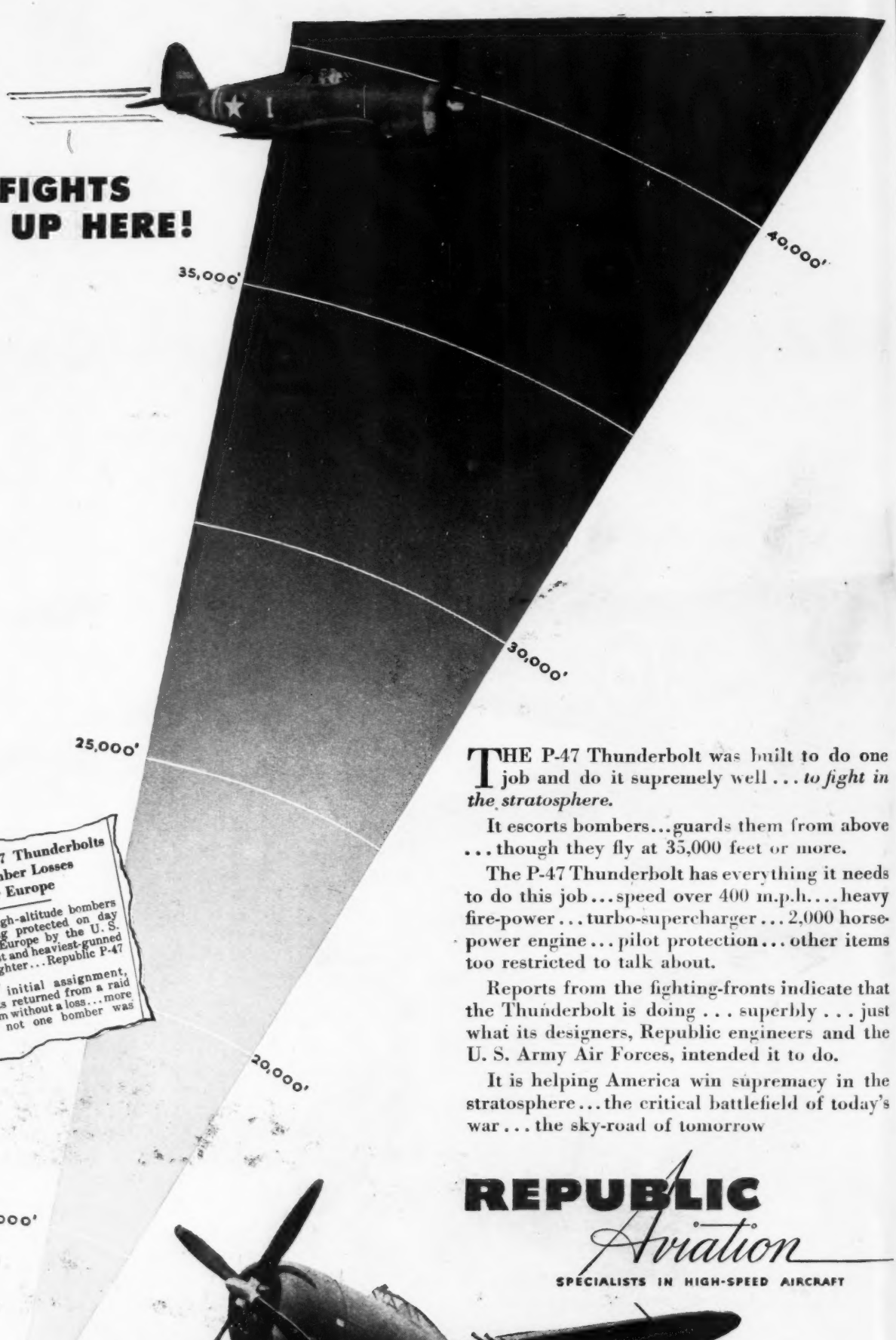


Universal Engine Cover Made by TWA

• In answer to the need for a cover suitable for several types of engines, TWA devised this waterproof canvas cover featuring special snaps which allow for different sized cowlings. On front is a heating duct opening so that a ground heater may be hooked up to blow heat in around engine. TWA system has found this cover very practical, in the absence of proper shelter in bad weather, or for general protection when plane is unexpectedly grounded away from base.


The de Havilland
Mosquito
equipped with
• Pressure Maintaining Valves
• Electro-Magnetic Valves
• Pneumatic Rams
• Oil Dilution Valves
• Fuel Tank Pressure Control Valves
• Electro-Pneumatic Supercharger Rams
• Altitude Switches
• Electro-Pneumatic Radiator Flap Rams
• Liquid Cooled Engine Header Tanks
• Thermostatic Pressure Relief Valves
• Thermostats

th STANDAIR Power Plant Controls
STANDAIR
STANDARD AIRCRAFT P CTS, INC.
TON, OHIO
SALES OFFICES—
Sterling Aircraft Produc , 1831 Graybar Bldg., New York City
L. M. Payne Company, Inc., 417 Curtis Building, Detroit, Michigan
Hartwell Aviation Supply Co., 3417 Crenshaw Blvd., Los Angeles, Calif.
Hartwell Aviation Supply Co., Huron Building, Kansas City, Kansas
Hartwell Aviation Supply Co., 608 North St. Paul St., Dallas, Texas



Republic P-47 Thunderbolts Cut Bomber Losses Over Europe

American high-altitude bombers are now being protected on day sweeps over Europe by the U. S. Army's fastest and heaviest-gunned single seat fighter... Republic P-47 Thunderbolt.

On their initial assignment, Thunderbolts returned from a raid over Belgium without a loss... more important, not one bomber was missing.

THE P-47 Thunderbolt was built to do one job and do it supremely well... *to fight in the stratosphere.*

It escorts bombers... guards them from above ... though they fly at 35,000 feet or more.

The P-47 Thunderbolt has everything it needs to do this job... speed over 400 m.p.h.... heavy fire-power... turbo-supercharger... 2,000 horse-power engine... pilot protection... other items too restricted to talk about.

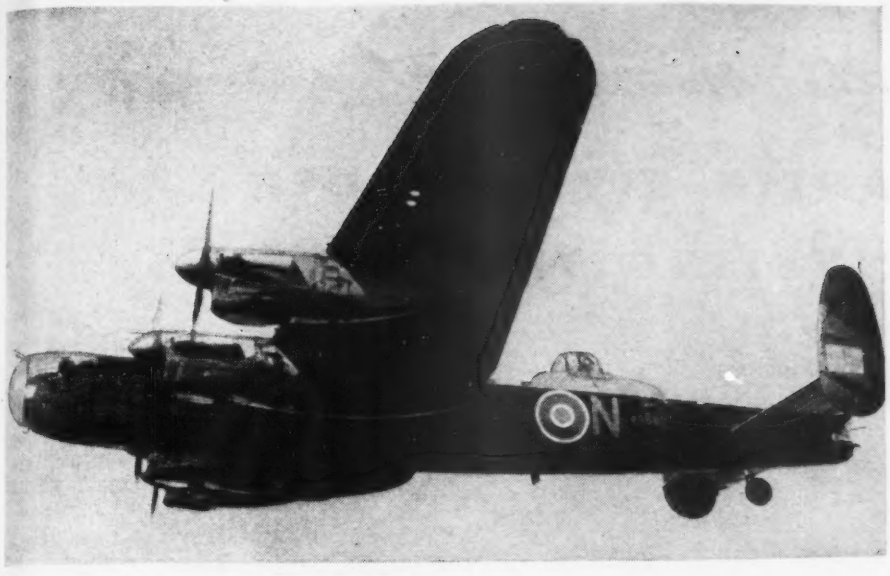
Reports from the fighting-fronts indicate that the Thunderbolt is doing... superbly... just what its designers, Republic engineers and the U. S. Army Air Forces, intended it to do.

It is helping America win supremacy in the stratosphere... the critical battlefield of today's war... the sky-road of tomorrow

REPUBLIC *Aviation*

SPECIALISTS IN HIGH-SPEED AIRCRAFT

REPUBLIC P-47 THUNDERBOLT



MILITARY

Due to concentration on combat craft, Britain has thus far had to rely on converted bombers and patrol craft for transport work. First straight-transport plane of British design since war started is Avro *York*, being developed from England's latest heavy bomber, Avro *Lancaster* (left).

British Bomber-Transport Conversions

By JOAN BRADBROOKE

Virtually all cargo and personnel carriers employed by the British are converted combat craft, with several prominent American types included. Our Ally's first pure transport craft since the war started will be the Avro "York," now being developed from the "Lancaster."

BRITAIN HAS BEEN handicapped throughout the past three and a half years of war by a shortage of transport aircraft. Even before the war there had not been enough commercial flying equipment because of the government preoccupation with expansion of the Royal Air Force. Since then the shortage of transport aircraft has become steadily greater due to the fact that production effort in Britain has been concentrated on the construction of military types.

Because, until recently, all regular British air services to and from Britain have been operated by British Overseas Airways Corp. as a civilian organization, the term "commercial" has frequently been applied to British operations. BOAC activities are on a civilian basis because many of the routes are by way of neutral countries.

To overcome the shortage of transport machines and to cope with the ever-extending air services needed with the spread of the war, a number of bombers and military types are now used as transports. They include Short *Stirlings*, Consolidated *Catalina* flying-boats, Armstrong Whitworth *Whitley V's*, Lockheed *Hudsons*, and Consolidated *Liberator* landplane bombers.

All these military types naturally had to be modified before they could be

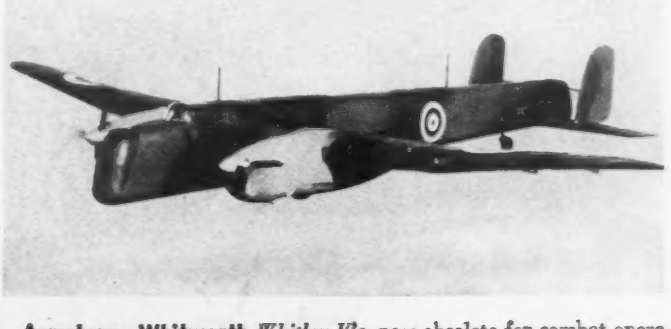
(*Turn to page* 319)

"Flight" photo

In addition to its early work as a bomber in European theater and present activity in Mediterranean area, Vickers *Wellington* (above) has been modified for transport work.

European photo

All-out warplane production in England has required calling into transport service many currently operational types, such as Short *Stirling* (above) and American types including Consolidated Vultee *Liberators* and PBY *Catalinas* and Lockheed *Hudsons*.



Armstrong Whitworth *Whitley V's*, now obsolete for combat operations have been converted as cargo carriers, some of which have been operated by BOAC. Note how nose and tail gun turrets have been removed. Extra fuel tanks have been fitted in bomb bays.

★

Another Martin First!

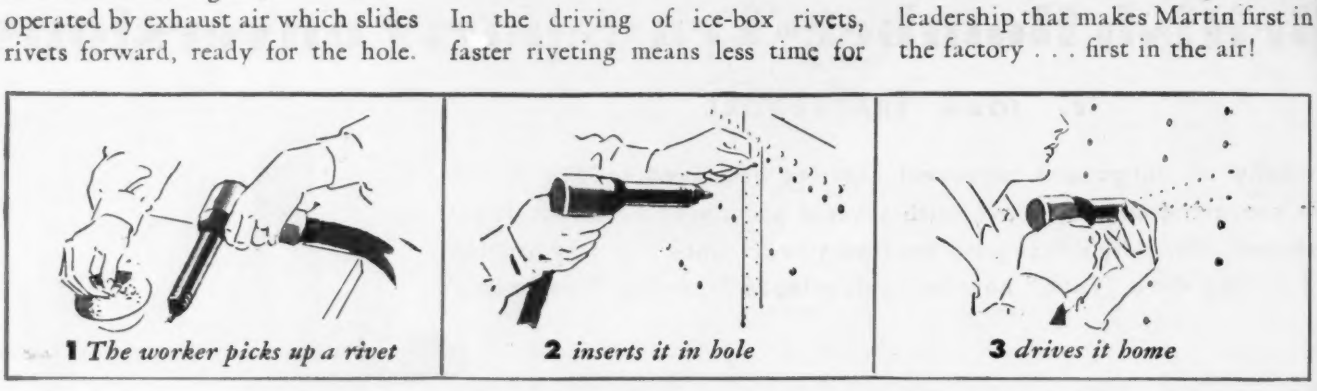
NEW MARTIN RIVET FEEDER CUTS RIVETING TIME 30%!

REDUCING riveting time on aircraft by 30%, this rivet feeder—a new Martin development—changes rivet guns from "single shots" to "automatics." Now undergoing work-tests, the feeder will soon be made available to all industry.

In the form of a magazine, attached to standard rivet guns, the feeder is operated by exhaust air which slides rivets forward, ready for the hole. With one movement of the gun, the worker puts the rivet in place; with another he drives it home. Picking up a rivet and inserting it by hand are eliminated; the worker's hands stay on the rivet gun until a clip is exhausted. Reloading consists merely of dumping rivets through a small door in the feeder.

In the driving of ice-box rivets, faster riveting means less time for rivets to warm up. Since they are untouched by the hand, they are cooler when driven home. The feeder costs nothing to operate, utilizing exhaust air from the rivet gun.

Suggested by a Martin inspector, it's an example of how Martin men and women work together to speed production. And it's an example of the leadership that makes Martin first in the factory . . . first in the air!



1 *The worker picks up a rivet*

2 *inserts it in hole*

3 *drives it home*

YESTERDAY 3 OPERATIONS

TODAY ONLY 2 OPERATIONS

Lower pictures show how the new device works. (*Left*) Without taking hands from gun, worker inserts rivet waiting at end of the track; (*Right*) drives it home. Results: Thirty per cent speedup in riveting, aviation's tightest bottleneck. *Warplants desiring further information write the Glenn L. Martin Company, Baltimore, Maryland.*

Martin
AIRCRAFT
Builders of Dependable Aircraft Since 1909

400,000 RIVETS hold MARTIN MARAUDERS together even when shot up like this one flying home over Tunisia. The new rivet feeder, by cutting riveting time thirty per cent, will speed victory by speeding output of MARTIN MARAUDERS, BALTIMORES and MARINERS.

Sperry Sight Supplants Gunner's Guess

Sperry Automatic Computing Sights have been installed in top and belly turrets of Boeing *Flying Fortresses.* They look somewhat like a newspaper photographer's camera.

MILITARY

DEVELOPMENT of a sight which automatically takes the guess work out of the gunner's job has been announced by the Sperry Corp. The sight, designed for use with Sperry hydraulic top and belly turrets, makes .50-cal. guns effective up to 1,000 yd.

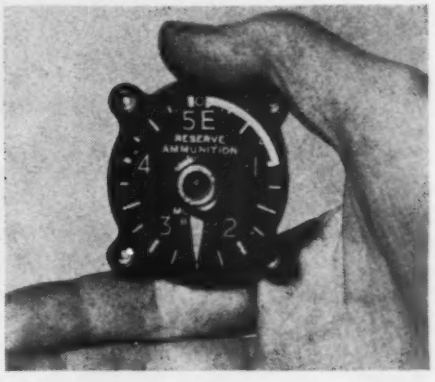
Known officially as the Automatic Computing Sight, the device has been in use on *Flying Fortresses* for some time. According to Thomas A. Morgan, Sperry president, company engineers were asked by military authorities to design a precision sight late in 1939. The first was delivered for tests in May, 1940.

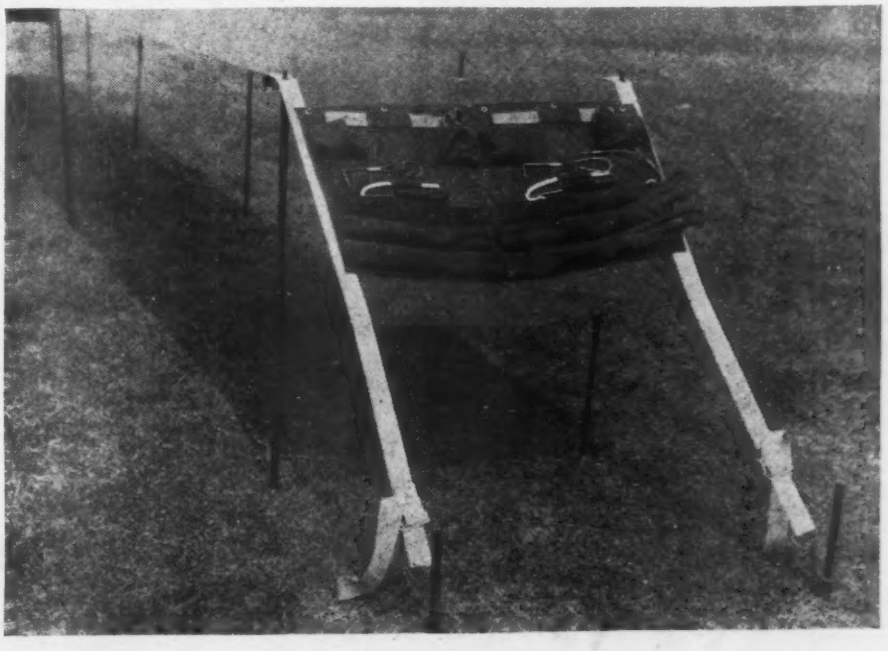
The heart of the sight is a camera-like black box which feeds on corrections and produces a hit. The gunner adjusts a knob on the box to the wingspread of the target. By controlling movement of the turret and working a foot treadle he keeps two illuminated vertical lines in the viewing lens on the tip of each wing of the enemy plane. The sight does the rest, automatically figuring gravity fall of the bullets, wind deflection, lead necessitated by speed of the target, and movement of the turret. The gunner need only identify the attacking plane, know its span, and sight directly on it instead of trying to estimate where his bullets ought to meet the enemy. The hydraulic turrets are made by Vickers, Inc., Detroit, a Sperry subsidiary.

Static Eliminator

• Elimination of static by attachment of a small device designed to fit aircraft or other type radio has been announced by Goodyear Tire and Rubber Co. Known as the "radio static neutralizer," the apparatus employs electron tubes which automatically distinguish between interference and desired radio signals. It is also expected to be useful on radar equipment.

• Pocket-watch-size ammunition counter has been developed by National Machine Products for mounting on an instrument panel where it shows the number of cannon or machine gun shells remaining. A small pilot light recessed in the center of the dial blinks at a constant rate with each shot fired as long as the gun is not jammed or overheated. Counter hands and numerals are in pale green fluorescent paint, and the last fifth of the dial has red fluorescent warning stripe. Counter is connected electrically to operating unit, which is actuated by gun bolt stud; current consumption for short intervals is .095 amp.





PARACHUTE SERVICING TABLE

Designed by Staff Sgt. George de Grange, AAF glider pilot, and manufactured by Luscombe Airplane Co., West Trenton, N. J., this table is being tested for use in combat zones by Army and Marine air forces. It is 43 ft. long, weighs less than 50 lb., and can be rolled to fit in a car rumble seat. Flanged legs can be driven in mud or sand and end straps adjusted individually to support kit, which contains tools for repacking and making minor repairs on all types of parachutes.

The envelope that helped to seal the fate of the Axis

• It was late summer 1940; war clouds were growing darker.

High-ranking Army Air Force officers and Republic Aviation officials at dinner were discussing "the perfect fighter plane."

Listening attentively, Republic Vice President and Chief Engineer Alexander Kartveli drew an old envelope from his pocket and proceeded to sketch as the others talked and aired their ideas.

Based on this original sketch a design in more technical form was later submitted to the Army. And the answer came back—"Go to it!"

May 6th, 1941 saw the first flight of the Thunderbolt—the P 47 that is today using its terrific punch to drive Axis planes from the skies.

* * *

Up where Nature's thunderbolts are born, the P 47 carries its six tons of lethal might, with assurance and with confidence in the superiority of its weapons, its speed, its maneuverability and its ability to withstand attack.

Attack from the elements—as well as the enemy. For the precious skin of the Thunderbolt is guarded by Valspar Val-Aero Aircraft Finishes. Sun, water, temperature extremes—Nature is licked when it tries its tricks. Corrosion is banished—vital camouflage preserved.

Valspar is proud that it rides to Victory with the Thunderbolt!

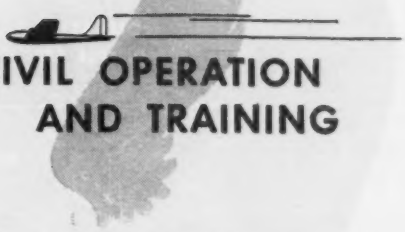
VALSPAR
VAL-AERO

A complete line of dependable Aircraft Finishes —that meet Government specifications. • Valentine & Company, Inc., Eleven East 36th St., New York, N. Y. • Established 1832 • Makers of the Famous Valspar Finishes.

When Is a Pilot Legally Liable?

By LEO T. PARKER
Attorney at Law

Encounters with the law can be complex-plus. This study of pertinent court decisions offers guidance to flyers and air service operators.



CIVIL OPERATION AND TRAINING

INJURIES to persons or to property resulting from airplane operations frequently involve liability and legal responsibility of the pilot. Sometimes the pilot is solely liable. In other instances both the pilot and his employer must jointly bear the responsibility.

First, it is important to know that various higher courts have recently held that an airplane pilot who causes the death of a person, negligently or while he is violating a State statute, may be criminally prosecuted for the offense of involuntary manslaughter, or even murder, and he is subject to a long term penitentiary sentence.

A recent higher court decision defined "involuntary manslaughter" as an instance where ". . . an individual, while not intending to kill another person does so while in the performance of an unlawful act, or as a result of gross negligence."

In a leading case (151 N. E. 489) the higher court sustained the manslaughter conviction of the lower court and explained that the operator may be held criminally liable, although he does not knowingly, intentionally, and recklessly operate the vehicle. This court said:

"It is his duty to regard safety regulations provided by the law and also conditions existing at the place where the injury occurs."

In still another case, a higher court held that a pilot who is so grossly negligent as to drive an airplane in reckless disregard to the safety of others, and thereby kills the occupant in his airplane, or causes death to another, such negligent pilot is guilty of the crime of manslaughter.

In other late higher court cases operators of motor vehicles were held guilty of murder, as in the case of Nichols (103 S. W. 2d 480) where, in Aug. 1942, a higher court held a motor driver guilty of murder and sentenced him to serve 10 years in a penal institution. Here, the aircraft aspect is that this court explained that the same law is applicable to all drivers of every kind of motor vehicle.

And quite obviously an airplane pilot is liable in damages for all injuries negligently effecting person and property. This is not new law, as it was first upheld several years ago. It means that any pilot who fails to exercise the same good judgment and care that would have been exercised under the identical circumstances by other prudent and reasonably experienced pilots are guilty of negligence and therefore personally liable for damages affecting other persons and property.

Therefore, the only requirement for a hired operator of an airplane to be personally liable for damages negligently effected is that he was in control of the airplane at the time of an accident.

Law of Testimony

The law of personal liability and responsibility of airplane pilots simply is copied from the usual and ordinary law previously applicable to others who have operated dangerous instruments. Thus, it is important to know that where a pilot is being prosecuted for manslaughter, or he is being sued for damages, only such testimony as may indicate his reckless acts *just previous* to the occurrence of the accident may be introduced as evidence.

In other words, the court will *not* permit the introduction of testimony which tends to prove that he was wont in the past to be reckless and careless. And no testimony by expert witnesses is admissible which relates to subject matter or negligence on which a jury must decide.

For instance, in the leading case of People vs. Crossan (261 Pac. 531), it was disclosed that the engine in an airplane stalled, and as the pilot was attempting to land near an ocean resort he struck and killed two girls.

Several eye witnesses testified that just before the airplane struck the two girls the pilot was flying his airplane along the beach at an elevation variously estimated as from 40 to 150 ft. above the sand. In this position he flew over a pier, rising somewhat as he did so and then coming down. Thereafter he flew a distance of several hundred feet to another pier, which he barely cleared, finally coming down a short distance south of the latter pier and striking the two girls.

The pilot himself testified that his engine stalled when he was 1,000 ft. in the air, and that he saw an apparent open space on the beach and headed for it. When nearly down, however, he stated he found too many bathers and therefore turned out toward the ocean, but the wind blew him against the girls.

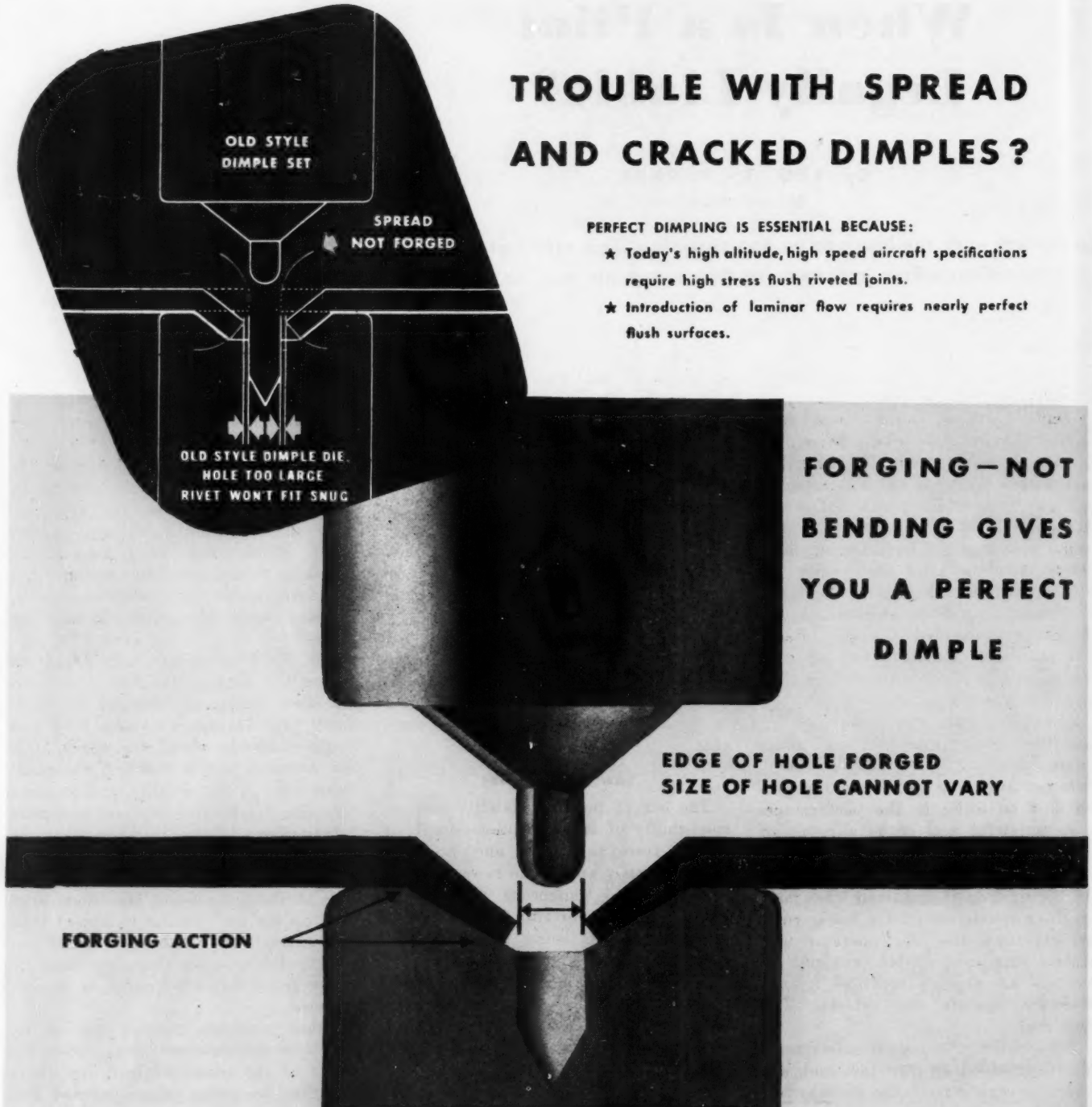
The State prosecutor was permitted during the trial in the lower court to introduce testimony showing that on many previous occasions the pilot had flown recklessly along the beach at a low altitude, barely clearing the numerous piers in that locality, and on some occasions frightening persons who were fishing from them; further, that he made a practice of flying over the boulevard at a height slightly below the tops of the lamp posts, sometimes stirring up the dust on the pavement with his wheels; and that on various occasions he swooped down so close to automobiles that the occupants became alarmed.

Other witnesses testified that at an air meet he swooped down over the heads of the crowd while doing stunts and that the police officers warned him to quit the practice. Also, it was proved that on the trip of the accident he was flying with a loose magneto and had only one gallon of gasoline in the tank.

The lower court convicted the pilot of the manslaughter charge—but the higher court reversed the verdict on the grounds that the testimony proving the pilot's reckless acts on other occasions was improperly admitted. The higher court said:

"Evidence as to the previous conduct . . . was improperly received, not only because of the fact that the matter was not in issue but also because of the fact that his habit was not competent . . . to establish the condition at the time of the accident . . . Witnesses were also permitted . . . to testify as experts that flying with a loose magneto

(*Turn to page* 316)



TROUBLE WITH SPREAD AND CRACKED DIMPLES?

PERFECT DIMPLING IS ESSENTIAL BECAUSE:

- ★ Today's high altitude, high speed aircraft specifications require high stress flush riveted joints.
- ★ Introduction of laminar flow requires nearly perfect flush surfaces.

AERO DIMPLE DIES GIVE STRENGTH WHERE STRENGTH IS NEEDED

Five solid years of concentrated effort on flush riveting in the aircraft industry staunchly support our sound principles of design and construction. The above illustrations and following features graphically portray the superiority of Aero Tool Dimple Sets.

—Aero Tool precision of manufacture holds a maximum tolerance of plus/minus .002 concentricity and plus/minus ½ deg. on the angle.

—Aero Tool Dimple Sets definitely conform to the nominal head dimension of the rivet.

—One-piece punches assure absolute concentricity of dimple, pilot and shank.

—Aero Tool Dimple Sets operate on the proven theory that forged holes are superior . . . hole spread is minimized, cracking eliminated. Forging results in structurally sound metal forming.

AERO TOOL CO.

ENGINEERED AIRCRAFT TOOLS

231 West Olive Avenue, Burbank, Calif. • Department Av-8

INFORMATION TIPS

KEEP POSTED ON
Products & Practices

This selected information on new publications and products is offered by the "AVIATION" Reader's Service through cooperation with the manufacturers. It helps executives save valuable time, provides profit through convenience. To obtain literature or additional data on new products described, simply fill in form below,* clip it to your letterhead, and mail. There is no cost, no obligation.

Machine Tool Control.....1
Conversion of variations in electrical impulses into hydraulic motion giving automatic regulation of milling, boring, shaping, and die-sinking for high-speed production is depicted in four-color folder on the Duplimatic control issued by Detroit Universal Duplicator Co., Detroit.

Template Production.....2
Use of photography in production of templates with data on various procedures is explained in detail in a booklet issued by Di-Noc-Cramer Corp., Cleveland.

Plywood Molding.....3
Bulletin No. 4 from The Resinous Products & Chemical Co., Philadelphia, contains technical data on flexible bag molding of curved plywood, a method involving use of an inflated or deflated bag as one of the halves of a pair of molding dies.

Non-Ferrous Castings.....4
Facilities of Howard Foundry Co., Chicago, for production of aluminum, magnesium, bronze, brass, and other nonferrous castings are described in bulletin which also contains weight comparisons and mechanical properties of magnesium.

Dimensional Charts.....5
Portfolio of 40 27x32-in. charts on theory and application of dimensional control has been prepared by The Sheffield Corp., Dayton, Ohio, for training of inspectors. Covered are basic definitions, principles of go and no-go gages, wear allowance, tolerances, fixed gages, and precision measuring instruments. Company has established nominal charge of $3.50.

Equipment Catalog.....6
Martindale Electric Co., Cleveland, is distributing Catalog No. 24 showing its line of products, including rotary files and de-burr tools, grinding points and wheels, commutator grinding and turning tools, and mica undercutting saws.

Industrial Rectifiers.....7
More than 50 portable and stationary industrial rectifiers are listed on catalog sheets No. 300 and 301 prepared by McColpin-Christie Corp., Los Angeles.

Tool Conservation.....8
Series of advertisements on cutting tool conservation has been reprinted in Bulletin No. 531 by Michigan Tool Co., Detroit. Included are hints on making the most of cutters, hobs, and hobbing worm gears.

Carbide Tools.....9
Wall chart and folder have been prepared by New England Carbide Tool Co., Cambridge, Mass., covering dimensions and prices of company's finish ground and carbide tipped tools.

Aircraft Rivets.....10
Folder contains specifications and shows installations of "Rivnuts," internally threaded and counterbored tubular rivets developed by B. F. Goodrich Co., Akron, primarily for use as nut plates in the attachment of de-icers.

Machine Attachment.....11
Experimental Tool & Die Co., Detroit, illustrates in folder savings in tools and set-ups in machine work through use of its Universal Slotmaster.

Centrifugal Dryer.....12
Features and specifications of centrifugal dryer for all types of plated work and lacquering small parts are listed in illustrated broadside prepared by Dellinger Mfg. Co., Lancaster, Pa.

Power, Test Units.....13
Two folders issued by Hydraulic Machinery, Dearborn, Mich., show respectively ten different models of hydraulic power units for production work and stationary and portable hydraulic test units for checking systems before and after assembly.

Machine Transmissions.....14
Fourteen installations of three models of transmissions for motorizing cone driven machine tools are shown in folder from Western Mfg. Co., Detroit. With capacities from 1 to 30 hp., transmissions can be used on lathes, shapers, milling machines, slotters, boring mills, etc.

Threading, Milling Machine.....15
Hall Planetary Co., Philadelphia, has issued catalog showing applications of its machines for planetary threading and milling.

Skin Cream.....16
Effectiveness of Tarbonis Cream, a coal tar application, in treatment of industrial dermatoses is listed in literature from The Tarbonis Co., Cleveland.

Speed Drive.....17
Midget variable speed drive developed by Graham Transmissions, Milwaukee, for aircraft and other applications up to 1/15 hp. is shown in engineering detail in folder from the maker.

Industrial Illumination.....18
Aircraft Industry Relations Committee, Toronto, is distributing Bulletin No. 19 containing engineering and general specifications for industrial lighting. Material was first prepared by Div. of Industrial Hygiene, Illinois Dept. of Public Health.

* AVIATION READER'S SERVICE — AUGUST

AVIATION, 330 W. 42nd St., New York City

Please send me additional information according to key numbers circled.

INFORMATION TIPS: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49

NEW PRODUCTS: 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105

NAME..... TITLE.....

FIRM OR AFFILIATION.....

ADDRESS .....

Duplicating Equipment 19

Hydraulic duplicating equipment for standard lathes, planers, shapers, grinders, and milling machines is featured in booklet issued by Turchan Follower Machine Co., Detroit.

Tubing Chart.....20

For convenience in ordering and to standardize sizes of aircraft seamless steel tubing, Michigan Seamless Tube Co., South Lyon, Mich., has compiled chart of most frequent thicknesses and outside diameters requested.

Bonding Jumper.....21

In Bulletin No. 22, Aircraft-Marine Products, Elizabeth, N. J., shows uses, features, and specifications of its "quick disconnect" bonding jumper.

Verniers, Gage Blocks.....22

Available to executives requesting it on their letterheads, *Handbook of Precision Measurements* has been prepared by Jansson Gage Co., Detroit, to help train inspectors and machinists in use of gage blocks and vernier instruments.

Zinc Steel 23

American Nickeloid Co., Peru, Ill., lists in leaflet sizes, gages, finishes, and properties of a new product, zinc plated steel sheet.

Safety Suggestions.....24

Material on production safety in manufacturing, compiled from the experience of foremen, is incorporated in Dept. of Labor special bulletin No. 10, *Safety Speeds Production*, which has been prepared for supervisors.

Plastic Parts 25

Control knobs, buttons, and other plastic parts kept in stock, are shown in folder released by Dayton Insulating Molding Co., Dayton, Ohio.

Carbon Steel Welding.....26

Two photomicrographs showing effect of pre-heating of plain carbon steel to eliminate cracks resulting from welding have been reproduced in broadside issued by Tempil Corp., New York City.

Aircraft Signals 27

Catalog of Electric Service Supplies Co., Philadelphia, lists noise output and construction of various model bells, buzzers, and horns for aircraft.

Machine Breather 28

Specifications and illustrations of various model breather-filters for engines and machines are being distributed in folder by Air-Maze Corp., Cleveland.

Welder Rating 29

Available from Welder Div., Hernischfeger Corp., Milwaukee, is brochure describing new Welding Service Range method of determining exact minimum and maximum current range of welding machines. System can be adapted to machines of other manufacturers by simply changing amperage calibration plate.

"White Prints" 30

Advantages of drawings done in maroon lines on white backgrounds are pictured in folder released by Ozalid Products Div., General Aniline & Film Corp., Johnson City, N. Y., which points out that lines show up clearly even when smudged with grease or dirt.

Aircraft Tires 31

United States Rubber Co., Detroit, has published technical and engineering data on aircraft tires in illustrated, 33-page booklet.

Finish Specifications 32

Service catalog of Army-Navy specifications for various aircraft finishes has been compiled by Lacquer & Chemical Corp., Brooklyn, N. Y.

Charts and Rules.....33

Method of viewing screens of comparators and micro and contour projectors with radius charts and measuring with projector rules are pictured in folder from maker, Universal Engraving & Colorplate Co., Buffalo.

Small Hobs.....34

Barber-Colman Co., Rockford, Ill., has compiled facts about small, fine-pitch hobs in catalog of illustrations, drawings, and specifications.

Gage Block Films.....35

Four 35-mm. sound movies on theory of gage blocks, their use and manufacture, and use of gage instruments can be borrowed or purchased at cost from Savage Tool Co., Minneapolis.

Aircraft Engines.....36

General Motors, Detroit, is distributing 80-page, illustrated, simply written booklet, *Airplane Power*, which particularly considers engine performances at various altitudes.

Die Catalog 37

Manual and catalog on cemented carbide dies, covering standard and special types for drawing wire, bar, tubing, and sheet metal, is available from Carboloy Co., Detroit.

Pipe Bends, Coils.....38

Alloy Mfg. Co., Pittsburgh, has issued folder illustrating types of stainless pipe bends and coils it is producing for aircraft.

Switching Units.....39

For use in reading a number of resistance-type strain gages under static loading, Waugh Laboratories, New York City, is marketing two types of multiple switching units described in folder from the company.

Personnel Records 40

Systems Div., Remington Rand, Buffalo, has published catalog of various types of recording and filing systems recommended for keeping employee records.

Brake Tester 41

Illustrations and text in broadside from Whiting Corp., Harvey, Ill., show features and operation of standard brake tester for planes up to 40,000 lb. Other bulletins describe assembly and engine stands, bomb hoists, cargo handling equipment, and the company's engineering service.

Standards List 42

More than 600 various standards, nine-tenths of them revised in the past year, are contained in new list available from American Standards Assn., New York City. A special section is devoted to war standards.

Metal Cleaning 43

Manual prepared by Magnus Chemical Co., Garwood, N. J., has sections on choice of compounds for metal cleaning and on various types of metal washing machines from dip tanks to continuous automatic apparatus.

Aircraft Fittings 44

Weatherhead Co., Cleveland, has released folder illustrating its aircraft tube, pipe, universal, and hose fittings and a bulletin of engineering drawings on AN, AC, and NAF fittings with charts showing how Army and Navy standard styles compare.

X-Ray Machine.....45

Philips Metalix Corp., New York City, presents in Engineering Bulletin No. 202, information on X-ray quartz analysis machine equipped with two goniometers which are said to nearly double crystal handling capacity.

Die Cushion Model.....46

How pneumatic die cushion equipment, applied to punch presses, automatically holds the blank in tension resulting in a smooth sheet, is shown in finger-controlled cardboard model distributed by Dayton Rogers Mfg. Co., Minneapolis.

Electrode Chart 47

Comparative chart showing which of 20 brands of welding electrodes fall within specified standard classifications and which can be interchanged has been prepared by Air Reduction Co., New York City.

Vacuum Pumps 48

American Automatic Typewriter Co., Chicago, has issued Bulletin No. 10 giving construction features and specifications for three sizes of vacuum pumps for laboratory work

Alcohol Molding 49

Electro-chemicals Dept. of E. I. du Pont de Nemours, Wilmington, describes the forming of articles with rubber-like qualities from plasticized polyvinyl alcohol in a booklet entitled *Molding Polyvinyl Alcohol*.

SH-H-H-H! THE ENEMY IS LISTENING!

● Sailors at sea couldn't listen to their favorite radio programs until one of our foremost radio manufacturers was commissioned to build a special seagoing receiver. It was found that ordinary radios "rebroadcast" and tipped off the ship's location. And without any radio, morale suffered.

Now, it's different! Sailors around the world are listening to radio programs from home through this low-radiation receiving set. The speed with which it was produced and put in service is a tribute, in part, to the ***E·L*** engineers asked to provide a suitable power supply. They did it—fast, and well.

This is just one of the many contributions to America's war effort which ***E·L*** research and specialized knowledge of vibrator power supplies and electronic circuits has made possible. You'll find ***E·L*** Vibrator Power Supplies on the job in all types of service, and on every front where the United Nations are fighting.

Wherever electric current must be changed, in voltage, frequency or type, ***E·L*** Vibrator Power Supplies and Converters offer a wide range of advantages, for peace, as well as for war.

For Operating Radio Transmitters in Lifeboats—E·L Model S-1229-B Power Supply. Input Voltage, 12 Volts DC; Output Voltage, 500 Volts DC; Output Current, 175 MA; Dimensions, 7½″ x 5½″ x 6¼″.

For Operating AC Radio Receivers from DC Current—E·L Model 262 Marine Power Supply. Input Voltage, 110 Volts DC; Output Voltage, 110 Volts AC; Output Power, 250 Volt-Amperes; Output Frequency, 60 Cycles; Dimensions, 10½″ x 7⅝″ x 8¼″.

Electronic
LABORATORIES, INC.

INDIANAPOLIS

E·L **ELECTRICAL PRODUCTS**—Vibrator Power Supplies for Communications . . . Lighting . . . Electric Motor Operation . . . Electric, Electronic and other Equipment . . . on Land, Sea or in the Air.

★ Just a little more than one year ago we were awarded the Navy "E" Burgee as a result of the tireless effort of "AUTOMATIC" employees in the continued production of equipment essential to the war effort.

Our organization, loyal to the core, has kept up the pace set when Uncle Sam first called for all out production.

So now, for the third time "AUTOMATIC" employees have won the Navy Production Award for meritorious service on the industrial field of battle.

The SECOND SILVER STAR has been placed on the Navy "E" Burgee we so proudly fly.

We'll keep it up—that is the spirit that prevails at "AUTOMATIC." Here we are all dedicated to the task of producing more and producing on time.

MANUFACTURERS FOR OVER 35 YEARS *Electric Propelled* INDUSTRIAL TRUCKS

AUTOMATIC TRANSPORTATION CO.

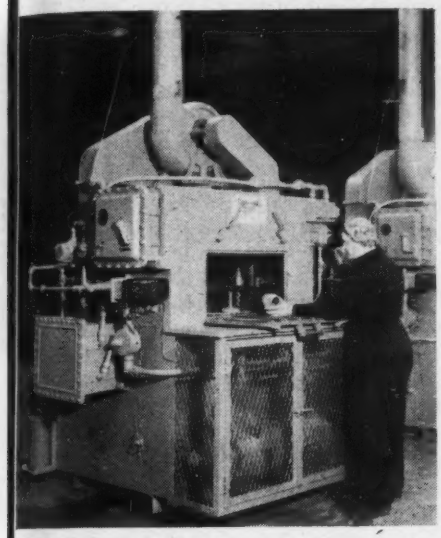
63 WEST 87th STREET — DIV. OF THE YALE & TOWNE MFG. CO. — CHICAGO, ILLINOIS

Latest Machine Tools

NEW PRODUCTS

Parts Cleaner **50**

Metal parts to be cleaned in this machine made by **Industrial Washing Machine Corp.**, New Brunswick, N. J., are placed inside on rotating mesh turntable 2 ft. or more in diameter. When door is closed, table turns under spray of any cleaning solution desired. Fresh water rinse drains directly into sewer.



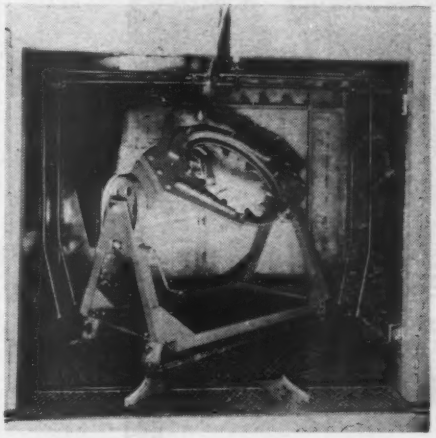
Machine fits into 5x6 ft. space. Model for use with kerosene (shown) is equipped with explosion proof switches and carbon dioxide fire extinguishing system.—AVIATION, *Aug.*, '43.

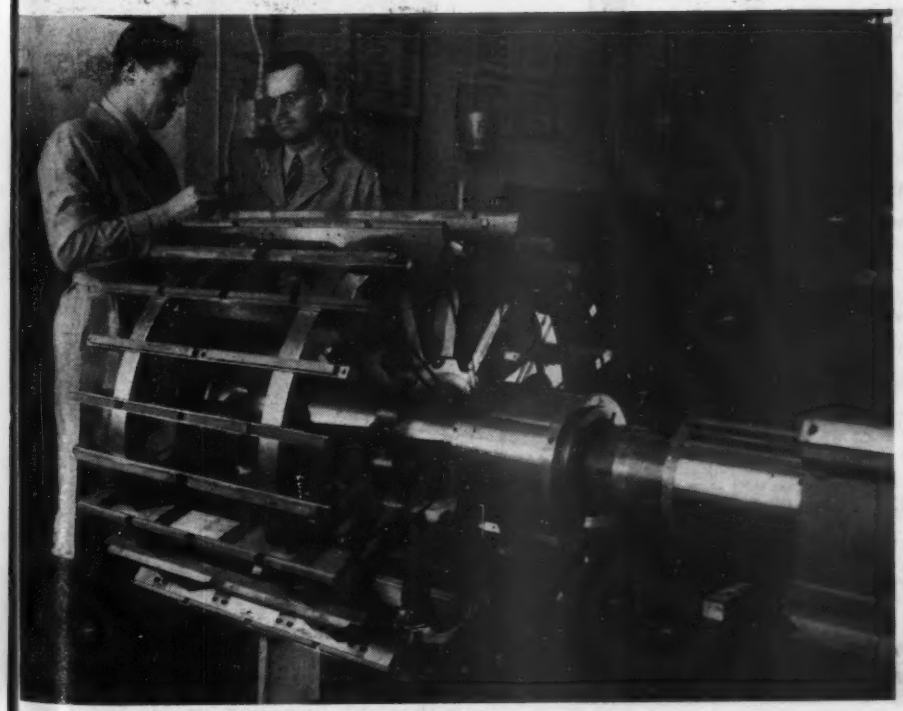
Giant Honer **51**

Shipped recently by **Micromatic Hone Corp.**, Detroit, hone abrading tool, termed largest ever made, is of 41½ in. dia., approximately 63 ft. long, and about 6,500 lb. in weight. It was designed to remove approximately ⅛ in. stock in a 40-ft. bore, or about 1,990 cu. in. under hydraulic control.—AVIATION, *Aug.*, '43.

Engine Washer **52**

Engines coming off assembly lines are rolled on their stands directly into





FENN

QUICK ACTION VISES

THIS work-tested, quick-action Vise has demonstrated its capacity for fast, dependable service for over twenty years.

Outstanding advantage is in the time-saving, easy-operating method of holding work securely and rigidly during machine operations.

No slow hand cranking to close the vise jaws on the material. Instead, a quick-action cam lever throws the jaws together instantly, evenly, solidly; then the eccentric handle locks the work in a doubly secure grip.

On jobs where there are milling, drilling, tapping and assembling operations—where a rugged, high-speed vise is required — that is where the FENN finds its place.

Three sizes - 4", 5" and 7".
Send for Bulletin No. 10

THE FENN MFG. CO.
HARTFORD, CONN.
ESTABLISHED 1900

THE 5TH FREEDOM

The life of every American will be fuller when, in the post war world, the amazing developments of modern aviation will be available to bring new freedom from barriers of distance. Among these developments is the constant speed, light weight Wickwire Automatic Propeller with its *fully* automatic pitch change—contributing to the speed, dependability and simplicity of family flying.

WICKWIRE SPENCER AVIATION CORPORATION

Blue Island, Illinois

(Subsidiary of Wickwire Spencer Steel Company)

this cabinet cleaning machine where, in about 20 min., they are washed, rinsed, and dried. Wash and rinse waters are pumped over the engine (which revolves at 4-6 rpm. on a turntable) through pipes extending around inside of cabinet. Drying is done by air blown at high velocity through a nozzle. Designed to accommodate any size engine and stand, cabinet illustrated is 13 ft. high and sunk 4 ft. below floor level to permit stand to be rolled in without lifting. Maker, **Howard Engineering & Mfg. Co.**, Cincinnati, states that smaller parts can also be washed in baskets placed on the table.—AVIATION, *Aug.*, '43.

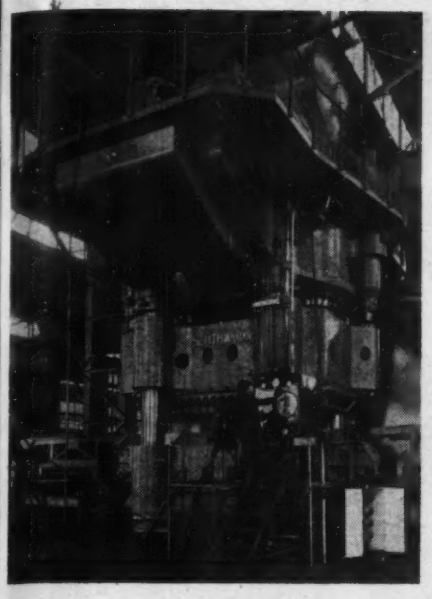
Heat Treating Units..... 53

On their way to work in the treatment of aluminum and magnesium alloy castings are a heat treating furnace and quench tank produced by **Despatch Oven Co.**, Minneapolis. Furnace, which will take three-section parts

basket 60 in. dia. by 84 in. deep, can be supplied with temperature range of 350 to 1,250 deg. F. supplied by direct gas fire or two-bank 170 kw. electric heaters. Gas-heated quench tank is designed for processing of aluminum alloy castings.—AVIATION, *Aug.* '43.

Parts Press..... 54

Shown is one of three 5,500-ton capacity hydraulic presses completed by **Baldwin Locomotive Works**, Philadelphia, for forming duralumin aircraft parts in a plant of one of our Allies. Pressure, operating speed, and length



of stroke are automatically controlled, with equipment also provided for semi-automatic and manual operation. Single casting steel platens weigh about 160,000 lb. each, and electric motors, which operate pumps, deliver a total of 400 hp. Platform, 30x23 ft., supports complete power unit, control gear, and operating valves. Height is 33 ft., total weight approximately 960,000 lb.—AVIATION, *Aug.*, '43.

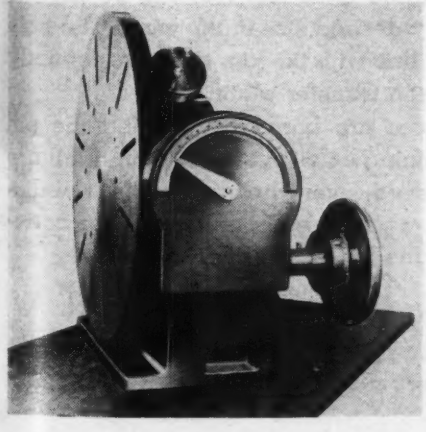
Roll-Grinder **55**

The Yoder Co., Cleveland, has designed new machine for grinding rolls up to 16 in. dia. Length between centers is 20 in. with manually synchronized table and cross feeds. Table feed has two speeds and head drive has nine speeds without belts or gear changes. Other features are high-speed, precision spindle, protection from dust, and centralized controls.—AVIATION, *Aug.*, '43.

Shop Equipment & Accessories

Measuring Table **56**

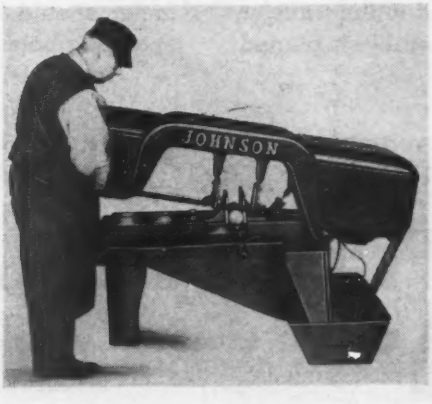
Facilitating the measuring of castings for radial engines, patterns, and other fabricated parts, new holding device consists of 36-in. circular table which can be adjusted to various positions. Work to be measured is clamped to table and then rotated or angled from vertical to



horizontal by geared turning wheels; positions are indicated in minutes of angles on dials, and a 10-in. sine bar is provided for close tolerances. Table can be locked in position while measurements are taken. Fixture is also said to be useful in holding boring mill set ups. An auxiliary table of 18⅞ in. dia. is available for smaller parts. Over-all height (when table is horizontal) is 27⅝ in.; base is 20½x27⅛ in., and weight 1,400 lb. Unit is made by **Machine Products Corp.**, Detroit.—AVIATION, *Aug.*, '43.

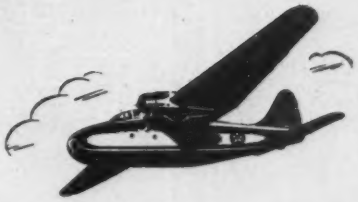
Metal Saw **57**

A wet model metal saw for high speed cutting is being produced by **Johnson Mfg. Corp.**, Albion, Mich. Non clogging piston pump is driven by noiseless cam from saw drive, eliminating need for separate motor. Since pump speed is automatically regulated by speed of saw,



The ultimate in safety for aircraft assembly:

WARM-SETTING *NON-ACID* PHENOL-RESIN GLUE



Such a glue (CASCOPHEN LT-67) is described in Technical Bulletin 104, sent on request.

Skilled engineering advice is available.

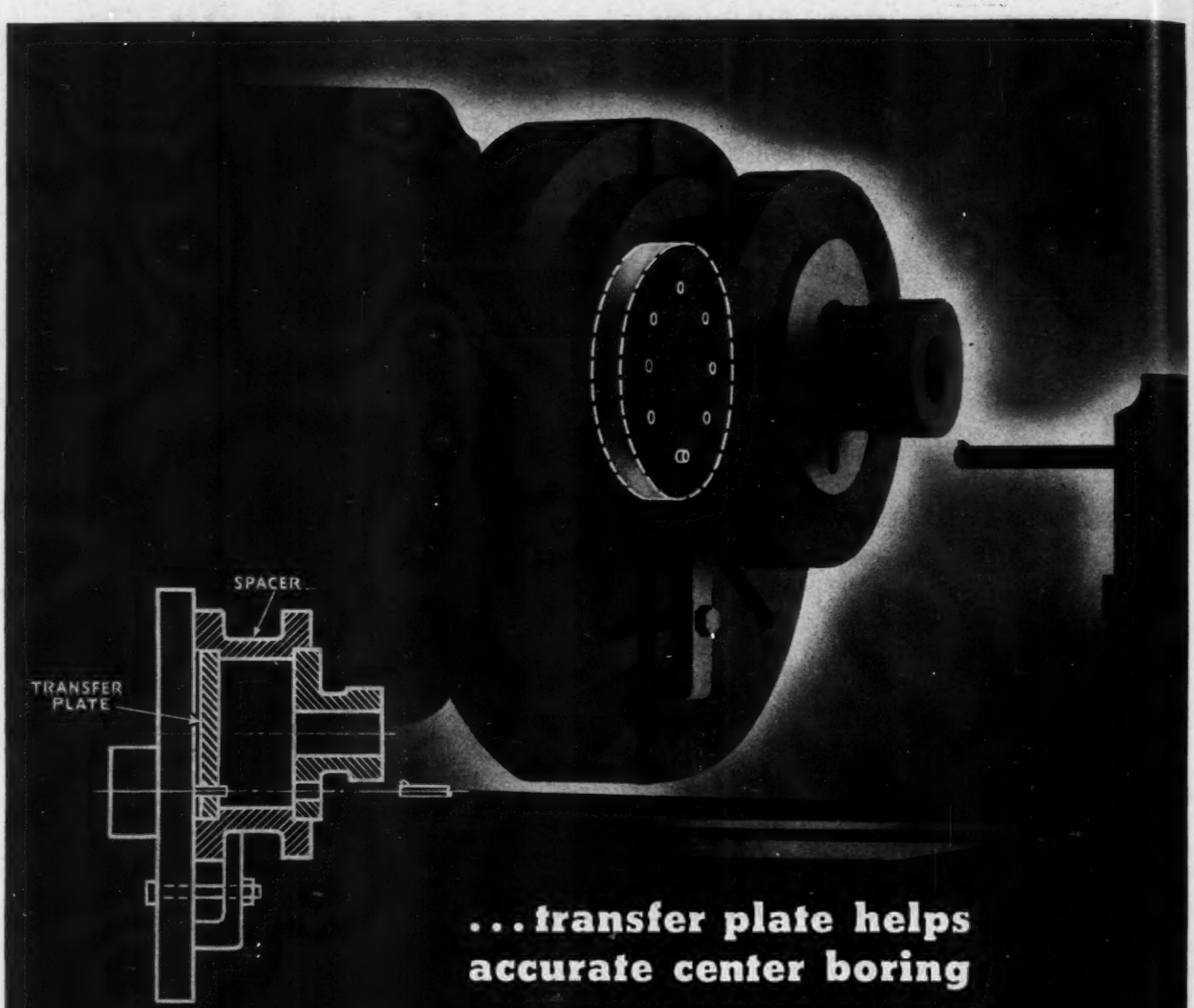
Address—Casein Company of America, (Dept. A8), 350 Madison Avenue, New York 17, N. Y.

CASEIN COMPANY OF AMERICA

Aircraft Glues

DIVISION OF THE BORDEN COMPANY

Phenol-resin, Urea-resin and Casein glues to meet all aircraft specifications



Information supplied by an Industrial Publication

The problem of drilling a number of holes in a part on precise center distances is seldom simple. It is particularly complicated in mass production of parts where holes must register accurately.

The answer in one plant is what is known as a transfer plate. This is really a circular template, of any thickness over ⅛ inch, with uniform holes drilled on accurate centers. These holes fit a pin located at the exact center of a lathe face plate.

In mounting, the work is assembled to the transfer plate with a spacer between. The assembly is pinned to the face plate through one of the holes in the transfer plate, and clamped tight.

A boring bar in the lathe tool rest can be used to bore a hole of any desired size in the work. The hole will be exactly in line with the pin, and consequently with the hole in the transfer plate.

Subsequent holes are bored by passing the pin through the remaining holes in the plate, until all are bored. When finished, every hole, regardless of diameter should be on the same center as the corresponding hole in the plate.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company
500 Fifth Avenue • New York City

MOLY

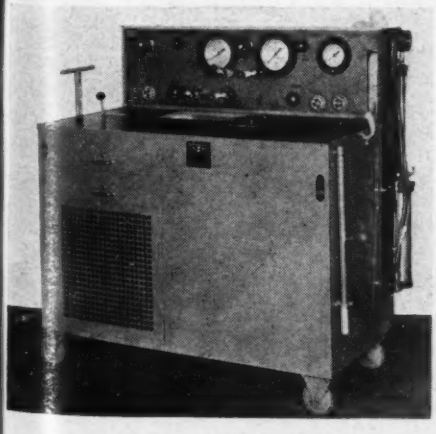
coolant flows in relation to rate of blade. Pump can be disconnected for dry cutting and can be installed quickly in present dry type saws produced by same manufacturer.—AVIATION, *Aug.*, '43.

Indicator Light 58

Searle Aero Industries, Orange, Calif., has introduced aircraft panel indicator light with make and break circuit and self-contained testing and dimming devices to eliminate switches, and rheostats. It can be made to any required diameter above $\frac{5}{8}$ in., barrel lengths of $1\frac{1}{2}$ to 2 in., and over-all lengths of $2\frac{7}{16}$ to $2\frac{13}{16}$ in. Dimming is controlled by turning rotating jewel assembly which adjusts shutter openings. Burn-outs are checked by pressing jewel assembly allowing current from regular lighting system to flow to bulb; failure to light shows that bulb is dead.—AVIATION, *Aug.*, '43.

Test Stand 59

Under patents pending, **Greer Hydraulics**, New York City, is now delivering portable hydraulic test stands for checking the systems and components of military aircraft. Selector valve provides for automatic control of either 1,000 or 1,500 lb. psi. in gal./min. flow; higher pressure is controlled by variable volume pump, lower pressure by an accumulator, regulator, relief, and check valves which prevent interflow between the systems. Shut off valve allows accumulator to be used as source of pressure and for fine control without the pump, which can be driven by either a $7\frac{1}{2}$ hp. electric motor or 20 hp. gasoline engine. Hand pump on the test stand provides finer control and pressures to 4,000 lb. psi. Pressure manifold can be divided by closing a valve so that power pump, which feeds one end, can check complete system, while hand pump, connected to other end of manifold, tests brakes or other components at the same time. Manifold gages—3,000, 6,000, and 500 lb.—can be isolated from each other to make specific readings. Valves on front of stand allow return flow to go either



TANK GUNNERS USE Ray-Bans

His eyes protected from tiring sun-glare by Ray-Bans, the tank gunner sights the enemy sharply, clearly. Especially developed to U. S. Army specifications years before the war, Ray-Bans scientifically *cut off* the glare-producing sun rays and transmit most of the light useful for seeing. Ray-Ban lenses by the thousands are being fitted into the masks and special goggle frames that equip many of our fighting men—the Army and Navy pilots, gunners, sky-troopers, ships' lookouts and plane spotters.

That's why Ray-Ban glasses are sold out to the armed forces—why civilian requirements for Ray-Bans are available *on prescription only.*

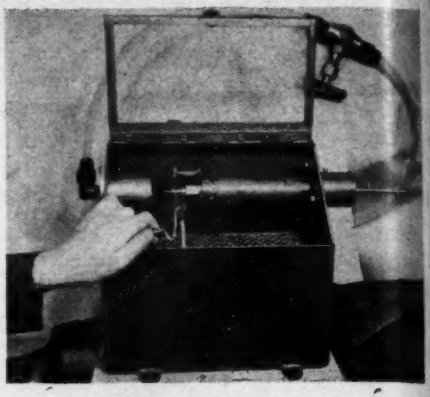
BAUSCH & LOMB
OPTICAL CO. ROCHESTER, N. Y.
ESTABLISHED 1853

AN AMERICAN SCIENTIFIC INSTITUTION PRODUCING OPTICAL GLASS AND INSTRUMENTS FOR MILITARY USE, EDUCATION, RESEARCH, INDUSTRY AND EYESIGHT CORRECTION

to 1,500 gal. reservoir or through flowmeter. Components can be tested on stand through two pressure and return outlets without disconnecting hose lines from the plane. Hydraulic systems can be cleaned and filled by oil from test stand reservoir and back through flowmeter. Booster will supply 1,000 lb. psi. air pressure to charge a plane's shock struts and accumulator. — AVIATION, *Aug.*, '43.

Bearing Washer..... 60

To remove all traces of smudge and dirt from bearings going into gyroscopic aircraft instruments and other devices, special washing machine has been developed to handle bearing races from ¼ to 1¼ in. o.d. The washer, 17x19x15 in., consists of a solvent container, fractional hp. motor, filter, and adapters over which bearing race is slipped. It is made by **American Foundry Equipment Co.**, Mishawaka, Ind. High pressure solvent is forced from a nozzle between race and balls of the bearing, which are rotated by a knob. To eliminate handling, a stripper mechanism removes bearings from adapter, whence they run down a chute into a container. While machine is in operation, working parts are covered by a transparent plastic window; cleaning solution recirculates through a filter.—AVIATION, *Aug.*, '43.

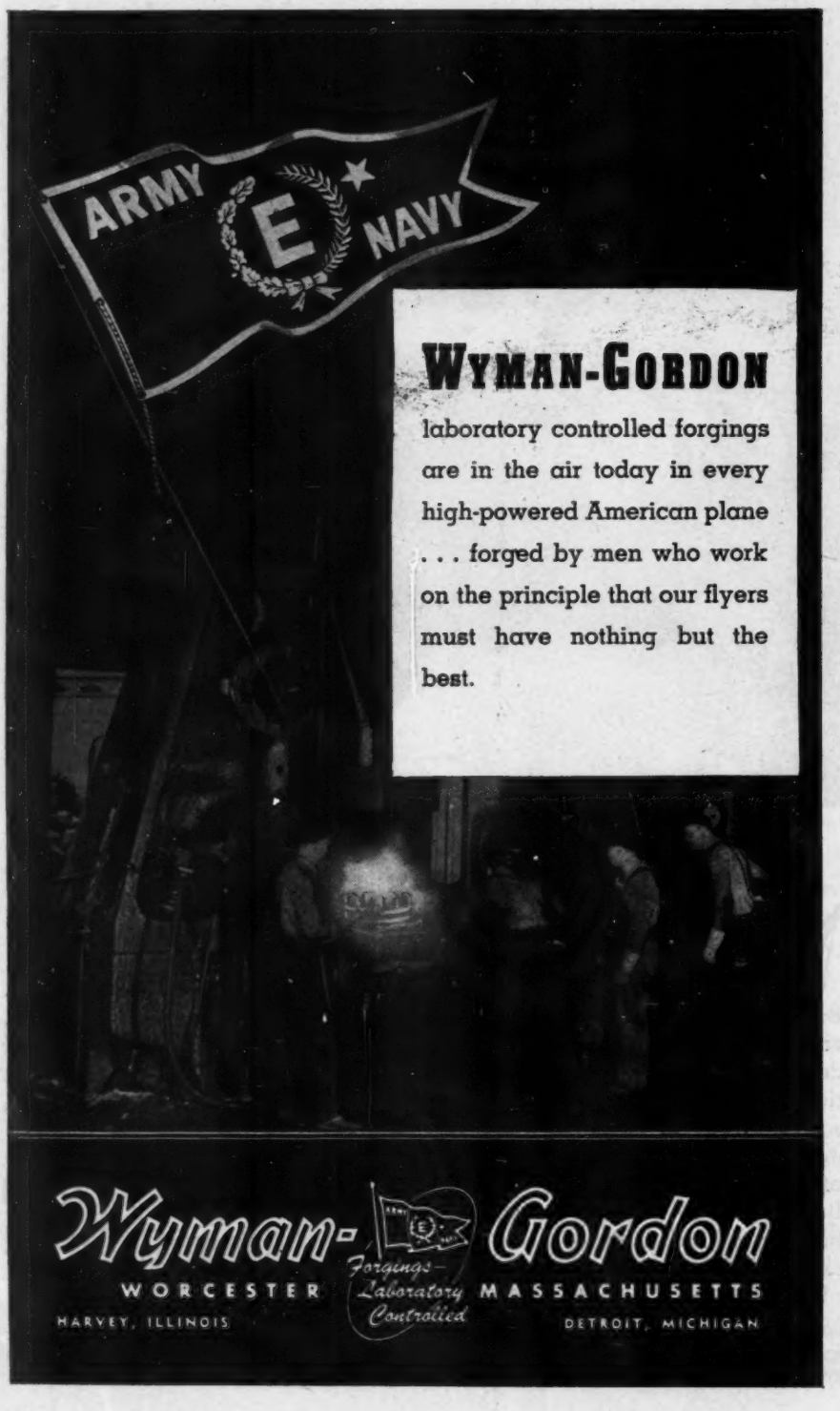


Metal Saw..... 61

Designed for slotting supercharger wheels, high speed metal saw is reported by **E. C. Atkins & Co.**, Indianapolis, to be useful for various other operations in metal where tolerances up to .0002 in. are required. Saws are .062 in. on tooth edge by .052 in. at mandrel with relief clearance ground at back of each tooth to depth of gullet. They are available in 3, 4, 5, 6, and 8 in. dia. for most standard milling machines.—AVIATION, *Aug.*, '43.

Spark Plug Cleaner 62

Eliminating use of fused nitrates bath, new method of cleaning spark plug shells announced by **Turco Products**, Los Angeles, involves one hour immersion in Turco type X solution, water rinse, half hour soak in Turco De-Scaler, second water rinse, and neutralizing dip in the X solution. Re-bluing should precede a final dip in oil to prevent rusting. Photo shows how dirty plug (right) looked after this cleaning procedure.—AVIATION, *Aug.*, '43.


ARMY
E
NAVY
WYMAN-GORDON
laboratory controlled forgings are in the air today in every high-powered American plane . . . forged by men who work on the principle that our flyers must have nothing but the best.
Wyman-Gordon
Forgings—Laboratory Controlled
WORCESTER
MASSACHUSETTS
HARVEY, ILLINOIS
DETROIT, MICHIGAN

The plane that caught the Axis *flat footed!*

THE Mustang is one of the finest performing fighter planes ever built for low altitudes. It has plenty of speed, is highly maneuverable and packs a healthy wallop. Even the British have lavish praise for this American plane.

The Germans had just brought out their new Focke-Wulf 190, a high altitude fighter, when the low-flying Mustang hit the scene. At low altitudes the Focke-Wulf could not match the flashing performance of the Mustang—and neither could any other German fighter.

Part of the Mustang's performance is obtained by use of SHELBY Seamless Steel Aircraft Tubing—the strongest structural form known for its weight. All excess poundage is eliminated from vital parts of fuselage and landing gear.

Plants of NATIONAL Tube Company are turning out SHELBY Aircraft Tubing in ever-increasing amounts to meet the new production schedules. All types and sizes are made in accordance with rigid government specifications.

Write for our new book on aircraft tubing giving complete details on types of steel, surface finishes, special shapes and many helpful tables that will save you time and effort.

SHELBY SEAMLESS AIRCRAFT TUBING *is available in all standard sizes and sections, made to exacting government specifications by the most modern processes developed by the world's largest manufacturer of tubular products.*

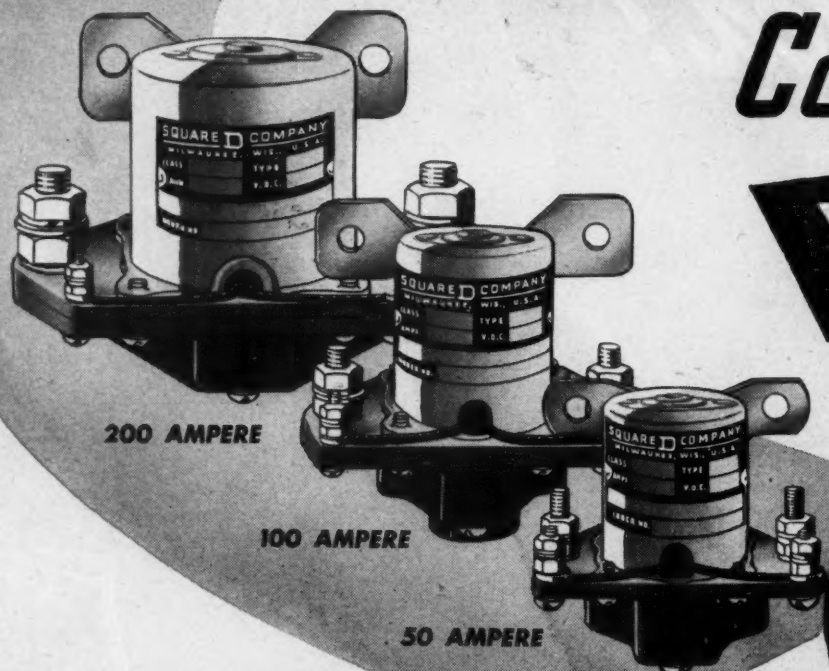
NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL

Now...4 sizes of Aircraft Contactors

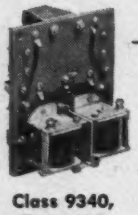


These new Type B2A, 25 ampere aircraft magnetic contactors are designed to the same exacting specifications as the 50, 100 and 200 ampere sizes. Simplicity of design and heavy duty contact capacity assure dependable performance under severe flight conditions.

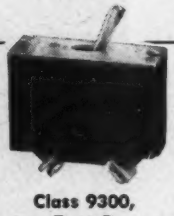
Class 9350 Type B2A contactors weigh only 7 ounces and are rated 25 amperes continuous duty for potentials up to 29 volts D.C. Successful operation is maintained under the vibration, acceleration and altitude conditions set by Army Air Forces specifications.

In addition to reversing and non-reversing contactors, Square D's broad line of aircraft devices includes circuit breakers in 5 to 125 ampere trip ratings—snap action push buttons—inverter relays and many other special purpose devices. A few are shown below.

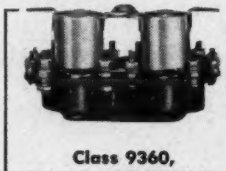
For complete details write for your free copy of the Square D Air-Line



Class 9340,
Type 975
INVERTER RELAY



Class 9300,
Type B
CIRCUIT BREAKER



Class 9360,
Type C-1 REVERSING
CONTACTOR

Class 9390,
Type 1003
TORPEDO SWITCH

Class 9390, Type OM
or CM "MUSHROOM"
PUSH BUTTON

ELECTRICAL EQUIPMENT • KOLLSMAN AIRCRAFT INSTRUMENTS

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

NEW PRODUCTS

Spring Retainer..... 63

A spring retainer which eliminates riveting of Dzus-type fasteners is announced by **Solar Aircraft Co.**, San Diego, Calif., and has been approved by

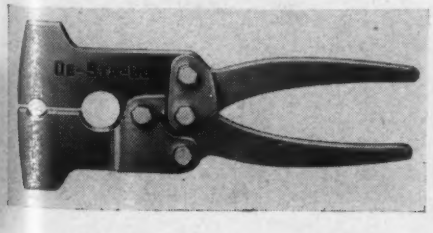
the AAF. Manufactured in four sizes, the new locking device has been named "Solac Retainer." Advantage claimed for it is elimination of riveting, which is replaced by spot welding. In removing a broken spring it is unnecessary to remove the retainer, thereby eliminating drilling out of rivets. A broken Dzus spring can easily be lifted out of the retainer with pliers (see photo) or by hand and a new one quickly installed.—AVIATION, *Aug.*, '43.

Self-Emulsifier 64

Gunk concentrate P-96 is said to be suitable as a substitute for petroleum sulphonates for cooling and grinding operations. **Curran Corp.**, Malden, Mass., announces that it is only necessary to dilute concentrate with three volumes of mineral oil and water as required.—AVIATION, *Aug.*, '43.

Holding Pliers 65

Toggle pliers made by **Detroit Stamping Co.**, Detroit, for holding cylindrical parts during manufacturing can be locked into desired gripping position and quickly released. Model 455 (illustrated) has capacity of $\frac{1}{2}$ to $1\frac{1}{4}$ in. o.d. Others can be bored or slotted to order.—AVIATION, *Aug.*, '43.



Speed Working Tools
for Precision Operations

New and Old Workers find SPINTITE the fastest wrench for speedy assembly of small parts.

Standard sizes with hex sockets from 3/16" to 5/8". Knurled Round and Square Sockets available on special order.

SPINTITE works like a screw driver

751 Set in Leatherette Roll includes 7 SPINTITES 3 screw drivers and chuck type handle

STEVENS WALDEN, INC.
461 SHREWSBURY STREET
WORCESTER, MASSACHUSETTS, U. S. A.

NEW PRODUCTS

Copper-Rubber Gasket..... 66

Reported in use in crankcases of many aircraft engines, new type gasket is composed of 80-mesh copper screening coated with synthetic rubber, resulting in a sealing said to be blow-out proof. Gaskets are being delivered to engine manufacturers by **Detroit Gasket & Mfg. Co.**, which is receiving rubber sheaths, .015 in. thick, from Goodyear Tire & Rubber Co., Akron.—AVIATION, *Aug.*, '43.

Steel Ink..... 67

To provide contrast with white scribed lines, new deep blue ink for use in layout work on dies, templates, machine parts, etc., is said to dry within a minute, resist abrasions and machine oils, and come off easily with application of alcohol. It is supplied in 4 and 16 oz.

bottles with brush applicator by **The Doall Co.**, Des Plaines, Ill.—AVIATION, *Aug.*, '43.

Chemurgic Rubber..... 68

Witcogum is name given new chemurgic rubber developed from vegetable oils for use in hose, tubing, insulation, gaskets, brake linings, etc., by **Wishnick-Tumpeer**, New York City. It may be used independently or as an extender by blending with natural, reclaim, or synthetic rubber. New material contains a guanadine accelerator and sufficient sulphur for curing in 30 min. under 40 lb. steam pressure at 287 deg. F.; compounding with carbon black and clay are said to increase tensile strength.—AVIATION, *Aug.*, '43.

Rivet Gun..... 69

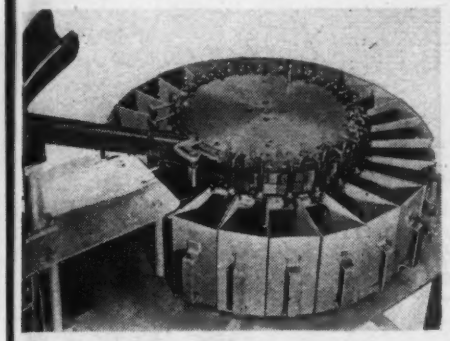
Cherry Rivet Co., Los Angeles, reports tests indicating that its blind rivets can be installed at new high rate using its newly designed, simplified pneumatic gun. With over-all height of 10⅝ in. and maximum diameter of 3¼ in., gun weighs about 4½ lb. and operates on pressure of 75 to 100 lb. psi. Three interchangeable heads are supplied for different size rivets. Clearance around rivet axis is ⅛ in., and tool is reported to operate in any position.—AVIATION, *Aug.*, '43.

FOR REMOTE POSITIONING OF...
AIR VALVES, TRIM TABS,
ENGINE COWLING FLAPS, ETC.
TRANSMITTER
MICROPOSITIONER
CONTROL MOTOR
BARBER-COLMAN
MICROPOSITIONER
This is the most important unit in a simple, rugged, powerful, and reliable system specially designed for remotely adjusting the position of valves, flaps, trim tabs and similar applications. When the transmitting Rheostat is set to the desired position, the Micropositioner (which is a polarized, voltage sensitive, direct current relay designed for the conditions of aircraft service) causes the Control Motor to assume the corresponding position. A transparent lucite cover permits contact inspection without removal of cover. Delicate construction and adjustments have been eliminated, to insure continuous accurate operation. Write for full information on specific applications. Ask for Bulletin F1781.
BARBER-COLMAN COMPANY, ROCKFORD, ILLINOIS

NEW PRODUCTS

Rivet Sorter 70

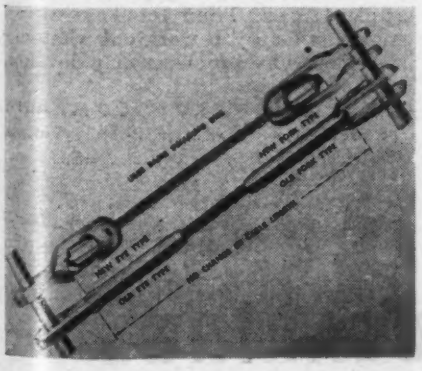
Based upon design developed by Fisher Body (AVIATION, Apr., p. 272), rivet sorter being marketed by **Southern Engineering Co.**, Los Angeles, has capacity of 50 to 60 lb. per hour. Sorter con-



sists of two units, one a series of drums to separate different heads, the other a series of four sorting disks for classifying according to length. Nine perforated descending drums in the screening unit are driven collectively by a ¼-hp. motor and sort rivets according to head sizes and shank diameters. Each of the disk sorters, mounted on tables 26x36x63⅞ in., has 22 selectors (see photo) for sorting the different heads and varying length rivets in diameters of $\frac{3}{32}$ to $\frac{7}{16}$ in. High savings with unit are reported.—AVIATION, *Aug.*, '43.

Cable Terminal 71

A new cable terminal said to effect a high savings in critical materials and to greatly expedite installation, is announced by **Poulsen & Nardon**, Los Angeles. Known as Socketype, the new terminals are approved to replace, and are interchangeable with, B types of present AN and NAF designs in aircraft. They are designed to match former types and, as cable lengths remain the



HIGH-ALTITUDE ASSIGNMENT

To meet the severe requirements of high-altitude flying, Packard Electric has developed a special high-tension aircraft cable with a tough synthetic rubber sheath protecting inner-braided insulation.

This Packard cable has been adopted by the Army Air Forces for planes which operate "close to the ceiling." It is qualified for the job by exceptional resistance to extreme heat, cold and corona, as well as to such common destructive agents as abrasion, moisture and age.

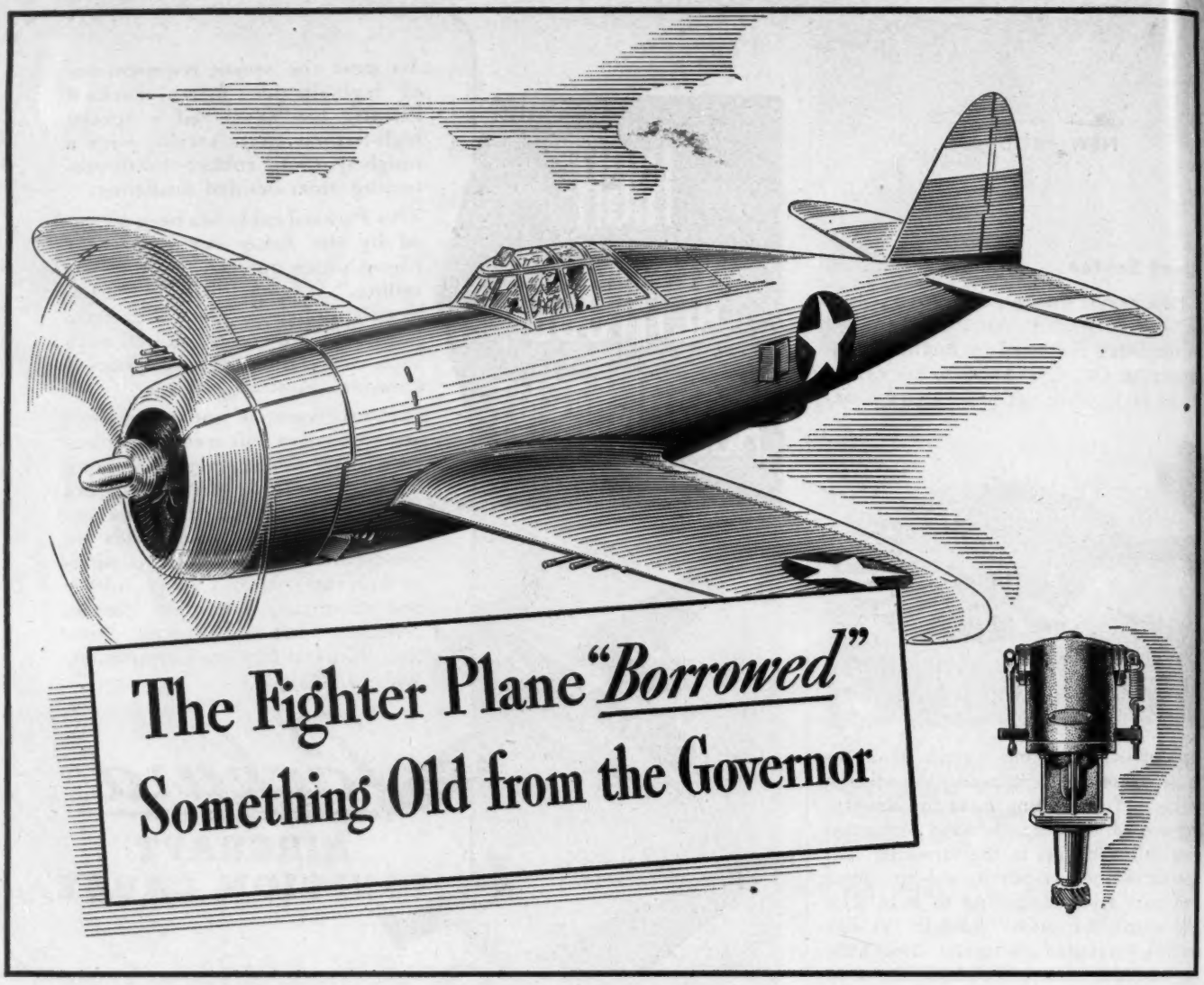
Packard research and experience are applied in full measure to aircraft cable developments. Among other important improvements pioneered by Packard is the extrusion of plastic compounds on low-tension aircraft cable, eliminating the use of critical rubber and improving insulation characteristics. Packard Electric Division, General Motors Corporation, Warren, Ohio.

Packard
REG US PAT OFF
TRADE MARK

AIRCRAFT IGNITION CABLE

ARMY E NAVY

PACKARD CABLE SERVES THE ARMED FORCES on trucks • jeeps • tanks • armored cars • planes • aircraft instruments • anti-aircraft gun controls • landing boats • radio equipment.



The Fighter Plane "*Borrowed*" Something Old from the Governor

IT MAY BE surprising to learn of vehicle engine governors having something in common with modern combat planes. In governor design, the problem was one of space limitations... and, of course, precision. So designers selected the Torrington Needle Bearing since it combined, happily, the necessary small size with a friction coefficient low enough to assure a high degree of accuracy in governor operation.

Builders of fighter planes, on the other hand, were confronted with an entirely different set of problems. A bearing for manual control mechanisms must not only conserve space and weight, but respond instantly—time after time. Yet strangely, or perhaps not so strangely, military aircraft manufacturers found what they, too, were looking for in the Needle Bearing. And other features as well, which came in mighty handy as the war took increasingly to the air.

In addition to this unique anti-friction bearing's compact design there was its effective lubrication, which helps keep 'em flying miles and often whole continents from maintenance stations... high unit capacity, meeting the rigid load and weight requirements of these fast, maneuverable aircraft... ease of operation, giving our pilots one more important edge in aerial combat...and ready availability—a vital factor helping to maintain and speed up our plane production.

DOES THIS SUGGEST TO YOU POSSIBILITIES for adapting the Needle Bearing to your postwar designs? The people you serve are going to want, in their own products after Victory, the revolutionary principles that have improved performance and cut costs in war production. And the Needle Bearing offers all of them—light weight, compact design, infrequent lubrication, dependable operation, plus installation ease unique in an anti-friction bearing. For preliminary information, write for Catalog No. 114, which lists sizes, ratings and typical applications. Then let Torrington engineers help you work out whatever specific service problems may develop.

NEEDLE BEARINGS— ALL TYPES—ALL SIZES

NEEDLE BEARINGS TYPE DC are complete, self-contained units consisting of a full complement of rollers and a drawn, hardened outer race. They offer the advantages of small size, low cost, high capacity—and easy installation.

NEEDLE BEARINGS TYPE NCS consist of a full complement of rollers and a relatively heavy hardened outer race. They are furnished with or without inner races. Needle Bearings Type NCS are adaptable to heavier loads than Needle Bearings Type DC.

NEEDLE ROLLERS TYPE LN are produced in a range of types and sizes for assembly on the job into low-cost, high-capacity, anti-friction bearing units. Our engineering department will be glad to advise on the correct size and type for any application.

THE TORRINGTON COMPANY

Established 1866 • Torrington, Conn. • South Bend, Ind.

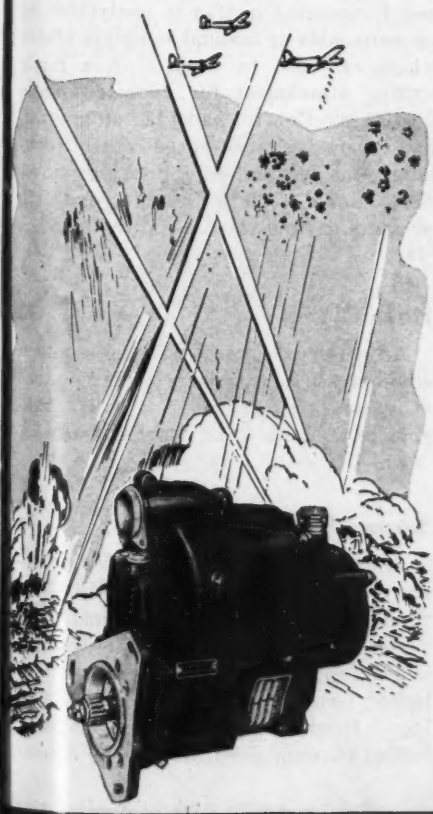
Makers of Needle Bearings and Needle Bearing Rollers

New York	Boston	Philadelphia
Detroit	Cleveland	Seattle
San Francisco	Chicago	Los Angeles
Toronto		London, England

LET'S GO, GAL... KEEP 'EM FLYING

TORRINGTON NEEDLE BEARINGS

The Last Thousand Feet



OUR heavy bombers and the enemy's ack-ack guns are pitted in an endless race for altitude. The last thousand feet make all the difference and present the supreme test of pilot, plane, and equipment. American Bosch magnetos were designed for that last thousand feet . . . built to perform unfailingly far higher than ever before required.

The dependable magnetos flowing from American Bosch assembly lines are the product of *modern* New England craftsmanship. American planes outfly the flak with the help of magnetos made by our *specialist* craftsmen — men and women, 20 to 60 years of age, trained for specific jobs.

The production success of these workmen results from American Bosch engineering, planning, and tooling — the same know-how that helps to get maximum power and service from engines.

In research, design, and production — war or peace — American Bosch serves all branches of the internal combustion engine industry.

AMERICAN BOSCH CORPORATION • SPRINGFIELD, MASSACHUSETTS

AMERICAN BOSCH

AVIATION AND AUTOMOTIVE ELECTRICAL PRODUCTS . . . FUEL INJECTION EQUIPMENT

MODERN CRAFTSMEN IN THE NEW ENGLAND TRADITION

A group of Carburizing Boxes made by the Pressed Steel Company and used by a large mid-western heat treater.

PIONEERS

FOR more than fourteen years we have been making Lightweight Carburizing Boxes because they usually outlast the cast iron box, are easier to handle and take less time to reach the required temperature. In these years all Carburizing Equipment manufactured by The Pressed Steel Company has passed from the experimental stage to a position of leadership wherever uniform high quality is required.

Reduce Overhead and Speed Production with Heat Treating Equipment manufactured by the "pioneer" in the field.

THE PRESSED STEEL COMPANY
of WILKES-BARRE, PENNSYLVANIA

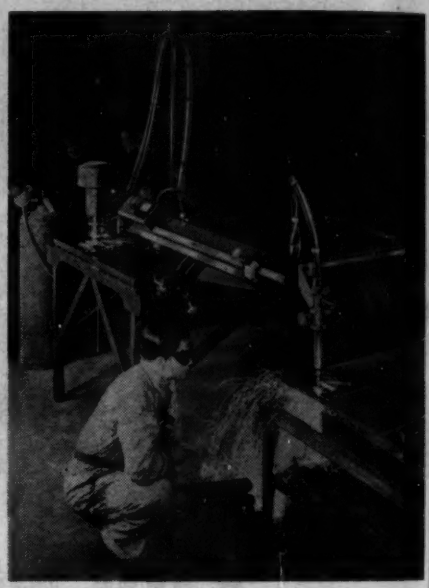
DETROIT: 337 Curtis Building • TOLEDO: 606 Nicholas Building
CHICAGO: 205 Engineers Building • NEW YORK: 254 West 31st Street
TORONTO, CANADA: A & M Accessories Ltd., 19 Melinda Street

PRESSED STEEL COMPANY PRODUCTS: Carburizing and Annealing Boxes, Thermocouple Protection Tubes, Seamless Steel Cylinder Caps, Seamless Steel Neck Rings, Welded Alloy Tubing for High Temperature and Corrosive Application, Radient Tubes, Inner Covers and Base Sheaths for Steel Mills

same, engineering changes are unnecessary and the same swaging dies may be used. Their simplified construction calls for stainless or alloy steels only in the cable-ends in which terminal is swaged. Cable-end fits in either fork or eye type socket permitting full swiveling action. In assembling swaging dies need not be removed.—AVIATION, *Aug.*, '43.

Gas Cutter..... 72

Unlimited variety of shapes are said to be possible with type JR gas-flame shape-cutting machine designed by **National Cylinder Gas Co.**, Chicago. Cut-



ting arm extends 24 in. from edge of table holding template and controls. Cutting torch can be set to cut bevels and its general motion is controlled by an automatic or manual template tracer which can also be fitted with a circle cutting attachment for diameters from 3 to 36 in. Control panel has stop, start, and reverse switches, speed control regulator and tachometer indicating movement from 2 to 35 in. per min., and high pressure oxygen valve.—AVIATION, *Aug.*, '43.

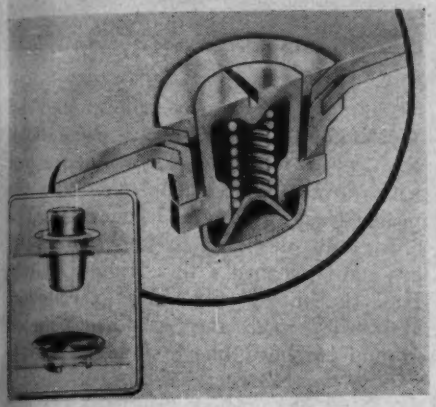
Hose Clamp..... 73

Adjustable to any size, hose clamp eliminates need for carrying large stock of various measurements. It is available from **Central Equipment Co.**, Chicago.—AVIATION, *Aug.*, '43.

Spring Fastener..... 74

Simmons Machine Tool Corp., Albany, N. Y., has begun production of Simlok fastener for cowlings, inspection plates, and panels. Device features a helical spring which holds sections in locked position; load is carried by steel lugs. Stud section is semi-permanently locked in outer sheet, but can be quickly

removed. When unlocked it is self-ejecting. After first installation, fastener is self-aligning. Unit, which can be



used in curved sheets of practically any radius, is cadmium plated.—AVIATION, *Aug.*, '43.

Plastic Molding..... 75

Photo shows 27x7¾ in. plastic control panel molded by new process which **Theodore Moss Co.**, Brooklyn, N. Y., reports reduces fabrication costs on small orders. Designed to replace aluminum parts formed on a steel die, thermoplastic panels are molded flat and bent over a forming model while in a semi-cured state; they are said to be considerably lighter than those made of aluminum in conventional ways.—AVIATION, *Aug.*, '43.

★ The tremendous developments, which have occurred in the aircraft industry in the past five years, have produced at Kay Products Company a unique and very comprehensive experience in aircraft welding, and production of aircraft parts and assemblies.

Organized just five years ago, for the sole purpose of serving the Army Air Forces and leading aircraft manufacturers, Kay Products has recently increased its facilities and personnel—so that *the welding skill and experience of this company can now be offered to a limited number of new customers.*

KAY PRODUCTS COMPANY

4825 CABOT STREET, DETROIT, MICHIGAN

DIVISION OF TYLER FIXTURE CORP., NILES, MICH.

AIRCRAFT WELDING

Landing Gear **76**

Leaf Spring Institute, Detroit, reports that AAF Materiel Center, Wright Field, has tested and approved new type leaf spring landing gear for use on PT-13 and PT-17 trainers. Cut, drilled, and bent from flat steel plate stock, the gear spreads out when the plane lands, and this sidewise motion is for the absorption of recoil without use of snubbers. The Institute states that other advantages include less stiffness in hard landings and no noticeable difference from conventional gears in takeoffs.—AVIATION, *Aug.*, '43.

Rescue Lamps **77**

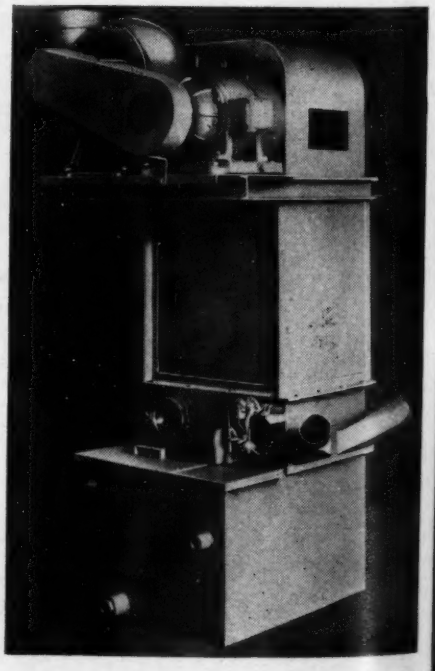
A 1,500 candlepower searchlight of midget size that theoretically can be seen 60 mi. at sea has been developed by **Westinghouse Lamp Div.**, Bloomfield, N. J., which reports that it will be packed with aircraft life rafts and take its power from a radio hand generator. The 6 w. bulb, designed to last about 100 hr., can be flashed with a trigger switch. Half the bulb is silvered as a reflector and waterproof lamp can be fastened around forehead like a miner's.—AVIATION, *Aug.*, '43.

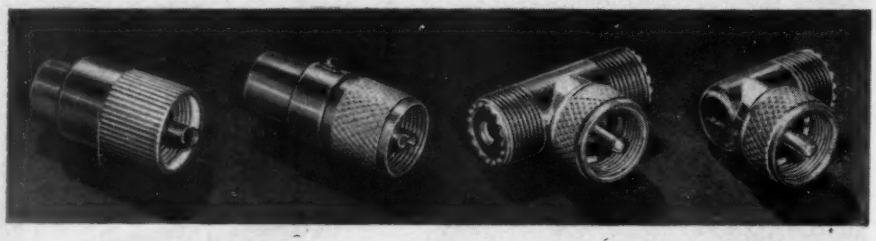
Milling Cutters **78**

McKenna Metals Co., Latrobe, Pa., is marketing cutters for various types of milling in a number of materials—steel (double negative rake angle cutter), in cast iron (positive rake angle), and in aluminum-silicon and magnesium-aluminum alloys, brass, and bronze.—AVIATION, *Aug.*, '43.

Dust Collector **79**

Designed for use with double spindle grinding and buffing lathes, particularly when working on magnesium, small orifice dust collector produced by **Industrial Equipment Corp.**, Detroit, has capacity





Busy Making "CONNECTIONS"

★ The operator at the switchboard is no busier making connections than is The Astatic Corporation now making crucial hours count in the volume production of many types of Army and Navy approved connectors, plugs and sockets for wartime radar and radio equipment. These important parts, now largely used and highly praised by many leading manufacturers of such equipment, include Astatic's precision-made Constant Impedance High Frequency Connectors, Coaxial Cable Connectors and Multi-contact Plugs and Sockets. Increased production facilities enable reasonably prompt deliveries to manufacturers supplying radar and radio equipment to government agencies.

ASTATIC

IN CANADA: CANADIAN ASTATIC, LTD. TORONTO, ONTARIO

THE ASTATIC CORPORATION

YOUNGSTOWN, OHIO

Keep 'em all flying

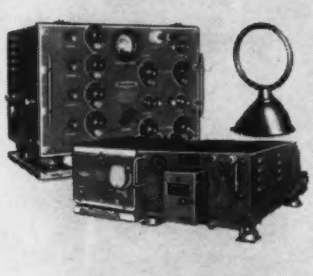
A copy of this United Nations poster, measuring 24" x 37" will be sent (while the supply lasts) to anyone who requests it on a company letterhead. Write to Koppers Company, Dept. A, Pittsburgh (19), Pa.

KOPPERS

THE INDUSTRY THAT SERVES ALL INDUSTRY

AMERICAN HAMMERED PISTON RINGS

"SEEING" through Fog and Darkness



RADIOMEN OF "THE INVISIBLE CREW"

These "Radiomen" have the ability to withstand extreme service conditions due to the painstaking efforts of Bendix Radio Engineers. No detail is too small to escape the grueling tests that insure unfailing performance. Electronic research continually steps up already high performance to exceed every standard previously reached.

BENDIX RADIO

Superhuman Vision with "THE INVISIBLE CREW"

Superhuman range, far into space . . . superhuman penetration, through darkness, cloud or fog . . . this is the electronic "vision" that Bendix Radio, through Radar, gives the pilot of U. S. combat aircraft.

With special electronic devices developed by Bendix Radio, he "sees" what lies ahead. He talks with fellow pilots, and keeps in touch with comrades on the ground. He picks up distant radio stations to guide him on his course.

Daily, as routine practice, he uses Radar and other electronic applications of Bendix Radio too confidential to talk about now. Through these members of "The Invisible Crew" he senses secrets of the future . . . the future that awaits his triumphant return.

More than 25 Bendix plants are speeding "The Invisible Crew" to world battle fronts.

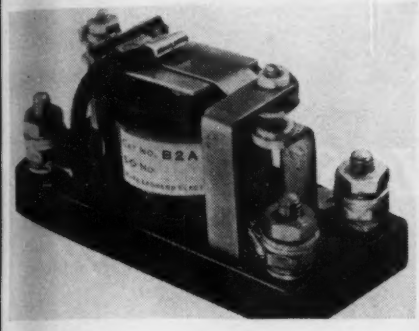
THE INVISIBLE CREW
Precision Equipment by
Bendix
AVIATION CORPORATION

BENDIX RADIO DIVISION

of 1,200 efm. Side compartment collects sludge for removal, and water level is controlled by diaphragm valve.—AVIATION, *Aug.*, '43.

Aircraft Relay 80

Designed for aircraft power circuits, new relay is said to perform under vibration and shock and high rates of acceleration and gravity. Single pole contacts are rated at 25 amp. at 24 v. d.c. non-inductive; contact gap and tail spring tension are adjustable. Base of molded bakelite nearly $\frac{3}{8}$ in. thick measures $1\frac{3}{8}$x$3\frac{1}{8}$ in. with two holes for mounting. **Ward Leonard Electric Co.**, Mount Vernon, N. Y.—AVIATION, *Aug.*, '43.

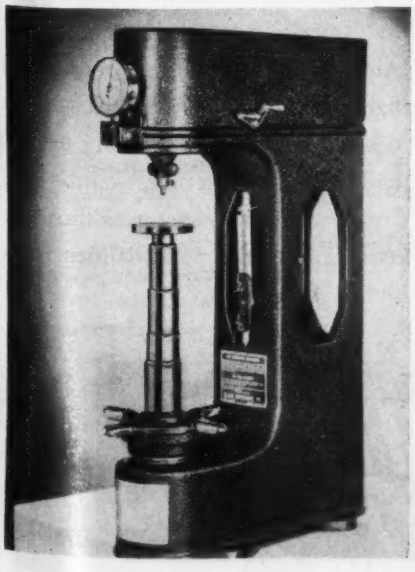


Hot Tinning Flux 81

Because of restrictions of use of tin and zinc, a series of lead-tin alloys, varying from 90 to 99 percent lead, have been introduced for hot tinning between 650 and 750 deg. F. The new fluxes, known as Fas-Tin, require a few additional operations on which its maker, **Hanson-Van Winkle-Munning Co.**, Matawan, N. J., will give manufacturers advice.—AVIATION, *Aug.*, '43.

Hardness Tester..... 82

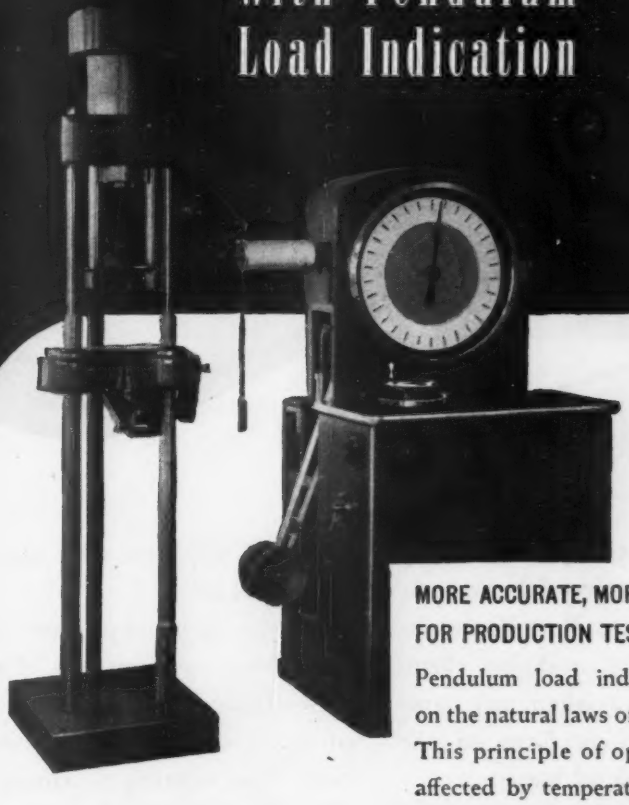
Improved hardness tester in three models is being produced by **Clark Instrument**, Dearborn, Mich., embodying frictionless spline, zero drag trip to eliminate friction or drag on the loading beam, dial indicator, and minor load adjustment. Enclosed elevating screw has self-lubricating oil reservoir and adjustable steady rest with two small V anvils. Standard equipment includes diamond cone and steel ball penetrators and anvils for flat bearing surface work, for standard size pieces and test blocks. AVIATION, *Aug.*, '43.



Oil Filter 83

Small gasoline engine drives rotary pump in new portable oil filter; exhaust gas flows through a jacket heating the filtering unit. The apparatus is available from **The Hilliard Corp.**, Elmira, N. Y., in sizes from 1 gal./min. to several hundred barrels per hour. It can be wheeled up to a plane, and connected

PRECISION
HYDRAULIC TESTING MACHINE
with Pendulum
Load Indication



MORE ACCURATE, MORE DEPENDABLE FOR PRODUCTION TESTING BECAUSE:

Pendulum load indicator operates on the natural laws of gravitation.... This principle of operation is not affected by temperature changes or subject to metal fatigue. . . . *Write for descriptive literature and quotations.*

ARMY E NAVY

RIEHLE
TESTING MACHINES
Division of
American Machine and Metals, Inc., East Moline, Illinois

Other Products: IMPACT TESTERS · VICKERS HARDNESS MACHINES
BRINNELL HARDNESS TESTERS · MEASURING INSTRUMENTS

UNDER the cover of military secrecy, a picture of the post-war world is developing. New discoveries in food processing, medicine, chemistry, electronics, aviation, and transportation are taking form on the sensitive film of global war.

What it will be like to live in the post-war world is known in part to some men — in total to none. Only when the people of the earth once more have the opportunity to exchange ideas, will we know what the whole picture will be.

And this exchange of ideas will not come about until travelers of all nations can cross frontiers in speed and safety . . . when goods can be shipped freely from country to country . . . when transportation has a new chance to show what strides it has made.

Fleetwings, by building planes and plane parts for United Nations' finest aircraft, has earned an important place in America's transportation future. Along with tremendous production of fighting equipment, Fleetwings, on its designing boards, is storing up ideas and planning for a new, exciting age of travel which will compress the oceans and expand the potentialities of the individual citizen.

FLEETWINGS

Division of Kaiser Cargo, Inc.

BRISTOL • PENNSYLVANIA

Plant No. 1

FLEETWINGS

pioneers with parts and hydraulic equipment

The BT-12, all-welded basic trainer built for the U. S. Army Air Forces.

VICTORY (rivets) IN THE BAG! The simple but ingenious trick of keeping rivets in little transparent bags, sorted for size, promises to result in a four-to-one saving in rivet cost at Fleetwings. By bagging the rivets, waste is virtually eliminated, mixing of sizes is negligible, and the heat-treated rivets harden less quickly because they are protected from outside air.

14 FLEETWINGS WORKERS WIN PRIZES! For suggestions to step up production and increase the flow of war material to our boys at the front, Fleetwings distributed cash awards to fourteen Fleetwings workers last month.

BACK IN 1937 when Fleetwings produced its first hydraulic valve, the production figures of today would seem fantastic. From that first valve (used on the pioneer stainless steel plane, the Seabird) has sprung Fleetwings' complete line which includes gun turret valves, single unit flap control valves, and solenoid-operated valves (automatic).

KEEP INFORMED: Write for "The Arrow," Fleetwings monthly magazine of timely news and hints on plane and plane parts production. Write your request on your company stationery. Address it to "The Arrow," Fleetwings Plant Number Two.

FLEETWINGS

Division of Kaiser Cargo, Inc.

BRISTOL • PENNSYLVANIA

directly to the oil system, thus eliminating the necessity of draining and batch reclaiming.—AVIATION, *Aug.*, '43.

Flashlight Battery..... 84

Reported in use by numerous aircraft manufacturers, 2 amp. hr. rechargeable battery for standard two cell flashlights

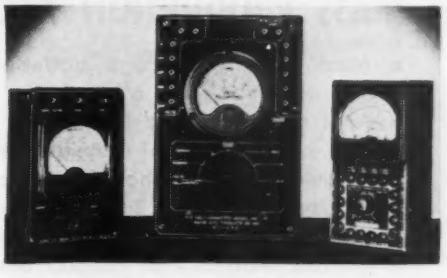
is said to give the service of 400 dry cells. Single and gang chargers for a.c. and d.c. supply are also available from maker, **Ideal Commutator Dresser Co.**, Sycamore, Ill.—AVIATION, *Aug.*, '43.

Field Welder 85

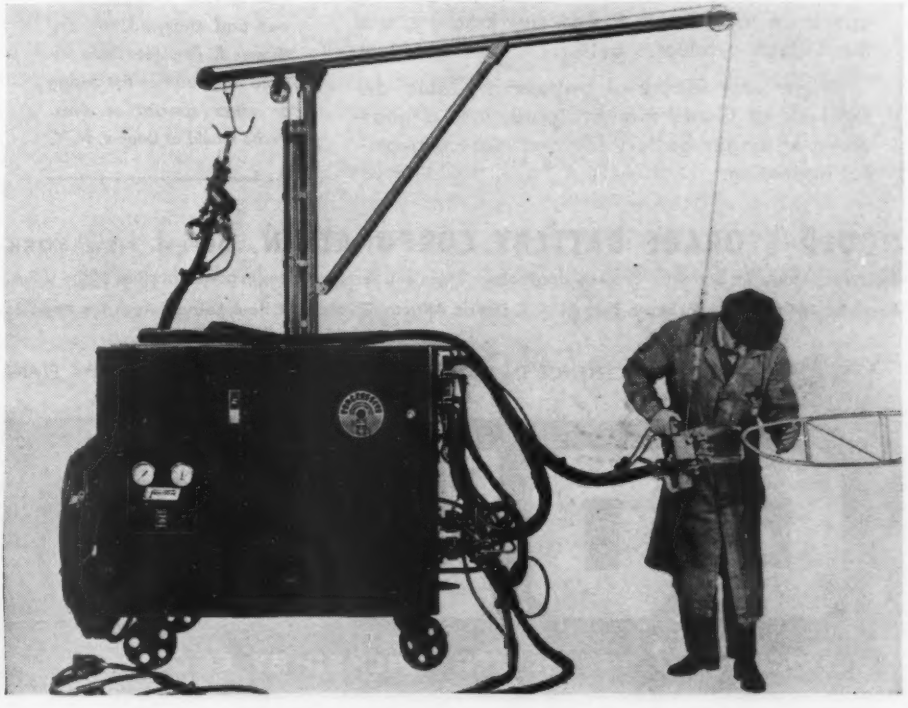
Equipped with electronic timer and selection of air and manual tong guns designed for variously shaped electrodes, portable cart is now available for spot welding of steel aircraft parts. Cables to power supply are only external connections necessary, since refrigerating unit, with air cooled condenser, takes place of water connections for cooling transformers, cables, and guns. Unit is a product of **Progressive Welder Co.**, Detroit.—AVIATION, *Aug.*, '43.

Electric Meters 86

Radio City Products Co., New York City, has introduced three new electrical test instruments. They are (left to right in photo): (1) Output meter with a constant impedance of 4,000 ohms and voltage ranges, controlled by selector switch, of 0-1.5/6/15/60/150. Condenser for blocking d.c. components is connected to separate terminals. (2) Volt-ohmmeter with sensitivity of 50 microamperes, d.c.



readings of 0.1 to 1,000 v. and 0 to 100 milliamperes, and resistance measurements of 0.1 ohm to 10 megohms. Self-

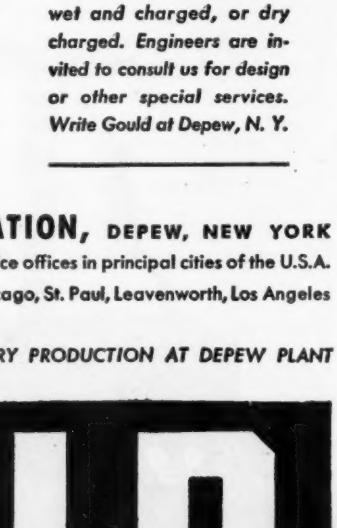


CUSTOM BUILT WITH MASS PRODUCTION ACCURACY

• Most industrial storage batteries are designed and made for a particular job. They are not mass produced in quantity. However, certain mass production techniques worked out by Gould engineers have been applied to many important steps in the manufacture of Gould industrial batteries. These have resulted in greater uniformity of product and a higher standard of quality.

For instance, the Gould grid casting machine pictured here has upped production from approximately 2,000 per day for the hand casting operation to 5,000 per day per machine, and the finished product is better.

When your industrial battery is Gould designed and Gould manufactured, it is a guarantee of longer battery life and more economical operation.



Specify GOULD Batteries

Designed especially for aircraft service. Supplied either wet and charged, or dry charged. Engineers are invited to consult us for design or other special services. Write Gould at Depew, N. Y.

GOULD STORAGE BATTERY CORPORATION, DEPEW, NEW YORK

Builders of industrial batteries for every application. Sales and service offices in principal cities of the U.S.A.

Factories at Depew, N. Y., North Bergen, N. J., Dallas, Atlanta, Chicago, St. Paul, Leavenworth, Los Angeles

FOR EXCELLENCE IN STORAGE BATTERY PRODUCTION AT DEPEW PLANT

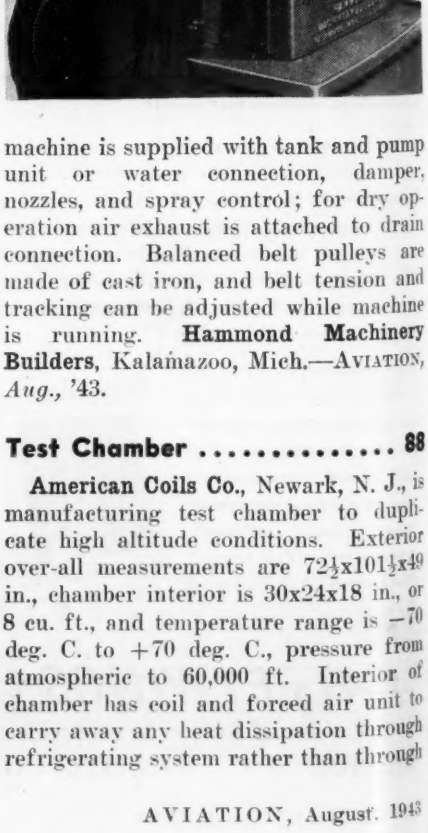
GOULD

Since 1898 THE BATTERY PICKED BY ENGINEERS

contained batteries supply energy for resistance measurements. (3) Multimeter with 200 microampere movement and sensitivity of 5,000 ohms per volt. Ranges are d.c. milliammeter 0-0.3/6/30/150, d.c. voltmeter 0-6/150/300/1500, a.c. voltmeter 0-6/30/150/600, output voltmeter 0-6/30/60/150/600, and decibel −6 to +50.—AVIATION, *Aug.*, '43.

Abrasive Grinder 87

Features of improved abrasive belt grinder are listed as heavy cast base, large sludge pan, and adjustability from vertical to horizontal position while running. Known as "Wet-N-Dri,"



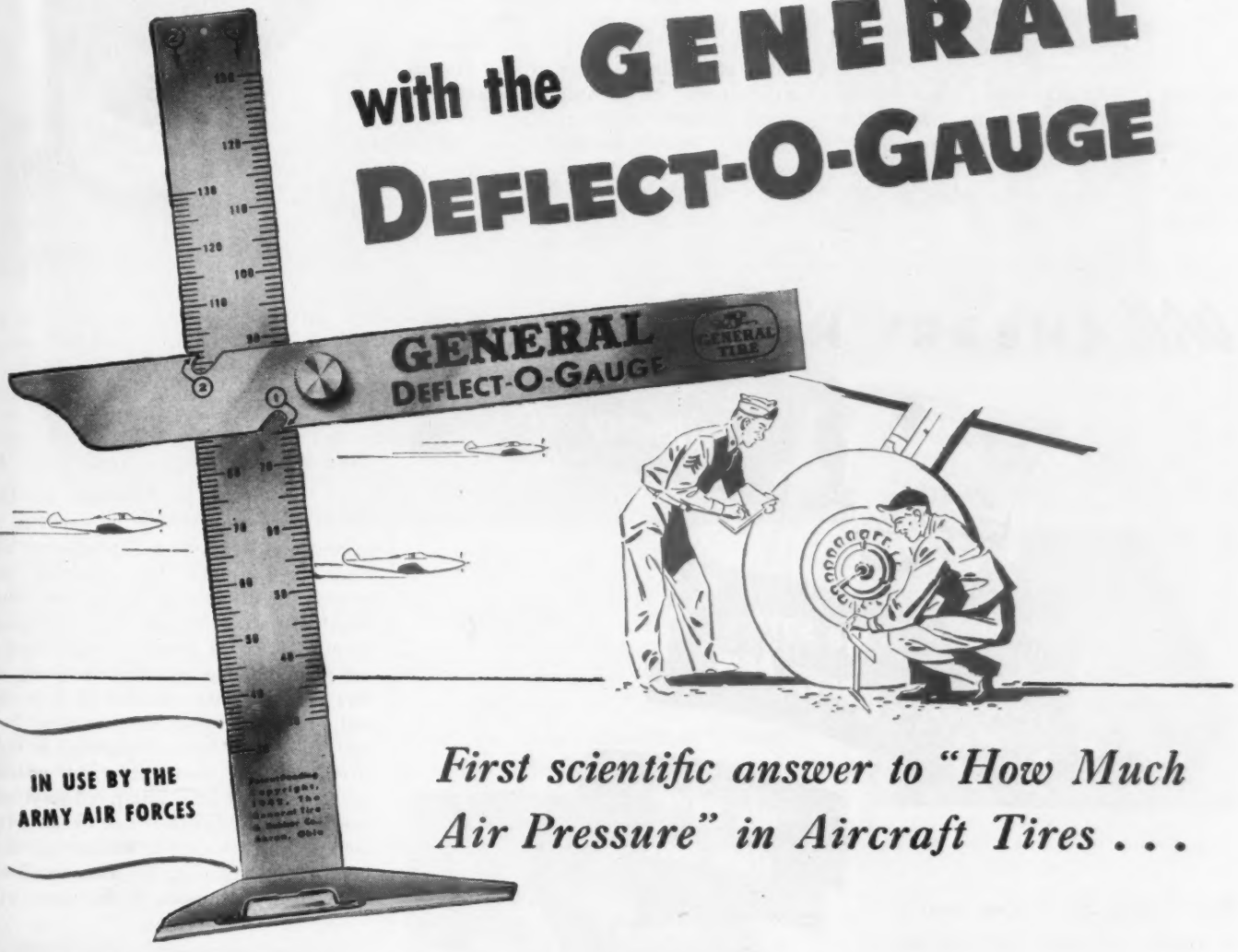
machine is supplied with tank and pump unit or water connection, damper, nozzles, and spray control; for dry operation air exhaust is attached to drain connection. Balanced belt pulleys are made of cast iron, and belt tension and tracking can be adjusted while machine is running. **Hammond Machinery Builders**, Kalamazoo, Mich.—AVIATION, *Aug.*, '43.

Test Chamber 88

American Coils Co., Newark, N. J., is manufacturing test chamber to duplicate high altitude conditions. Exterior over-all measurements are 72½x101½x49 in., chamber interior is 30x24x18 in., or 8 cu. ft., and temperature range is −70 deg. C. to +70 deg. C., pressure from atmospheric to 60,000 ft. Interior of chamber has coil and forced air unit to carry away any heat dissipation through refrigerating system rather than through

ANOTHER AVIATION "FIRST" FOR GENERAL TIRE . . .

with the GENERAL DEFLECT-O-GAUGE



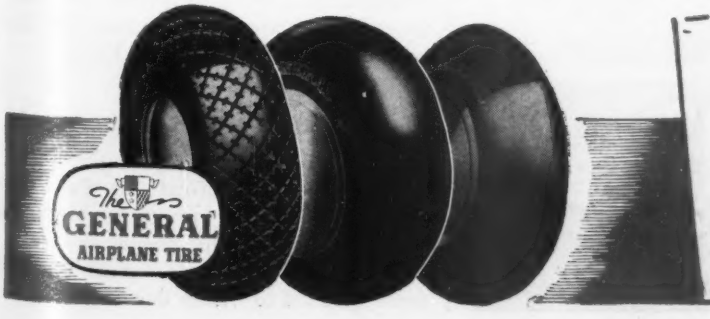
First scientific answer to "How Much Air Pressure" in Aircraft Tires . . .

● Out of The General Tire & Rubber Company's long, practical experience in the design and manufacture of aircraft tires and other aviation products, comes this new, scientific instrument for designating *correct aircraft tire pressures* . . . regardless of load!

The General Deflect-O-Gauge, developed by aircraft tire engineers, takes up where the ordinary "air-pressure" gauge leaves off! Easy to use . . . but a precision instrument that *measures tire deflection.* Indicates absolutely accurate limits for variable as well as static loads on all Type I, (Smooth Contour), Type II, (High Pressure), Type III, (Low Pressure), Type IV, (Extra-low Pressure) and Type VI, (Low Profile) aircraft tires of any make, and begins a new era of accuracy in aircraft tire maintenance.

The General Deflect-O-Gauge is made of high quality steel, plated for protection . . . calibrations are easy to read . . . spirit level on base assures correct readings. Comes packed in a sturdy, attractive wooden case, the General Deflect-O-Gauge can be assembled in 10 seconds. For further information, fill out the coupon and mail to Aviation Division, General Tire & Rubber Company, Akron, Ohio.

THE GENERAL TIRE & RUBBER COMPANY
AVIATION DIVISION • AKRON, OHIO



Clip this coupon . . . send for informative instruction booklet for the General DEFLECT-O-GAUGE . . . Address: Aviation Division, The General Tire & Rubber Company, Akron, Ohio.

Name _____

Company _____

Address _____

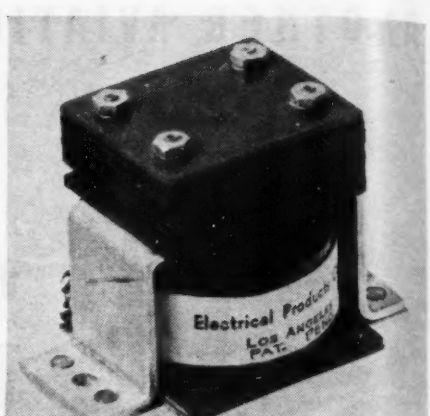
City and State _____

NO CHARGE — Mail this today! — NO OBLIGATION

the walls. Chamber can be dehydrated and then sealed before pre-heating for obtaining low relative humidities. Changes can be made in the chamber without affecting the refrigerating unit. —AVIATION, *Aug.*, '43.

Midget Relay 89

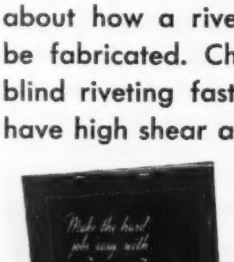
A new midget relay with a factory-sealed chamber for provision of tamper-proof safety is announced by **Electrical Products Corp.**, Los Angeles. Sealed chamber serves as an arc quencher and reduces fire and explosion hazards. Rated at 25 amp., the relay will operate satisfactorily at 50 amp. and has been tested without failure at 120 amp. high inductive load. An over-travel spring insures positive contact pressure and instant break release. The unit has withstood Army tests of overload, vibration 55 cycles per second with .06 in. excursion, acceleration of 10 gravity units, and salt spray tests of 240 hr.—AVIATION, *Aug.*, '43.



With CHERRY RIVETS

The Cherry Blind Rivet makes it highly practical for the engineer to design up to efficiency without too many worries about how a riveted product can be fabricated. Cherry Rivets make blind riveting fast and easy. They have high shear and fatigue values so they may be used in either primary or secondary structures.

The speed of factory operations makes an appreciable saving in manufacturing costs. In field repair Cherry Rivets save time, where time counts most.



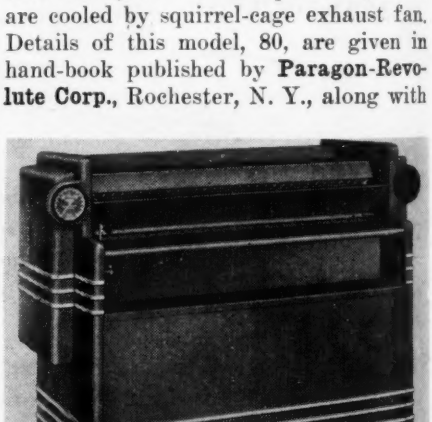
CHERRY RIVETS, THEIR MANUFACTURE AND APPLICATION ARE COVERED BY U. S. PATENTS ISSUED AND PENDING.

The complete story on Cherry Rivets is clearly presented in the Handbook A-43. Request your copy today, Department A-110, Cherry Rivet Co., Los Angeles 13, Calif.

Cherry Rivet Company
LOS ANGELES, CALIFORNIA

Blue Printer 90

For companies whose needs for blue prints have expanded from small to intermediate stage, new reproducing machine is available for exposing blue prints, direct process prints, and sepia negatives up to 54 in. wide at speeds from 6 in. to 32 lineal ft./min. Operating principal incorporates revolving, direct contact glass cylinder of 8 in. dia. and a mercury vapor lamp drawing 75 w. per lineal in.; meter connected in lamp circuit records operating time, guaranteed for 1,000 hr. Lamp and cylinder are cooled by squirrel-cage exhaust fan. Details of this model, 80, are given in hand-book published by **Paragon-Revolute Corp.**, Rochester, N. Y., along with illustrations and descriptions of other reproducing apparatus made by this company.—AVIATION, *Aug.*, '43.



Height Gage 91

Among precision measuring tools being produced by **McGrath St. Paul Co.**, St. Paul, Minn., are vernier height gages, vernier calipers, 3-in. pocket slide calipers, and four sizes of glass surface plates ground to within five wave lengths

WIN A WAR BOND . . . tell why

dag COLLOIDAL GRAPHITE

REG. U.S. PAT. OFF.

IS IMPORTANT in the Manufacture or Use of Each of the 4 Items Illustrated

*How "dag" Colloidal Graphite is Used for Impregnation and Surface Coatings

At the right you find out how to win a War Bond. Here you find how **dag** colloidal graphite is used by industry for purposes other than those illustrated above.

Asbestos packing, clutch facings and brake linings are impregnated with **dag** colloidal graphite to provide the lubrication which increases both their effectiveness and their service life.

Abrasive wheels are impregnated to reduce frictional heat of operation and to make them electrically conductive elements for use in electrical grinding control circuits.

Paper is impregnated to give it electrical conductivity, to reduce its translucence, or to color it.

Electrical insulation (final layers) is impregnated to reduce corona on windings of electrical machines.

The fabric in laminated plastics used in bearings, bushings, etc. when impregnated produces less frictional resistance and has a much longer service life.

Impregnating textiles, ropes and cables reduces interfiber friction and gives the materials greater resistance to wear.

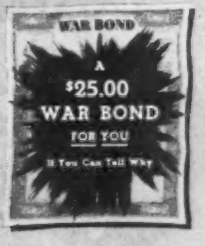
Porous bearing metals impregnated have a lower coefficient of friction and maximum service life.

Coating drive belting with colloidal graphite makes it possible to bleed-off static charges of electricity.

*A TYPICAL APPLICATION

Write for free bulletin No. 431H **"dag** Colloidal Graphite for Impregnation and Surface Coatings."

How to Win



Acheson Colloids Corporation will give a $25.00 War Bond to each of the 5 people who submit complete and accurate answers together with the 5 best letters on the question, "Why is **dag** colloidal graphite important in the manufacture and/or use of each of the products pictured here?" (1) State business connections (no one in the graphite field or their families is eligible). (2) All entries must be legible. (3) All entries must state the publication in which the advertisement was seen. (4) Entries must be postmarked not later than September 15, 1943. (5) In case of ties, duplicate awards will be made. (6) Entries become the property of the Acheson Colloids Corp. (7) The verdict of the judges will be final.

These are two of the War Bond winners. Others will be introduced in subsequent issues.

Mr. C. J. Krister, member of the research staff of E. I. du Pont de Nemours & Co., Inc., Grasselli Chemicals Dept., Wilmington, Delaware.

Mr. J. William Glenn, Chief Chemist, General Chemical Company, Buffalo Works, Buffalo, New York.

dag COLLOIDAL PRODUCTS

ACHESON COLLOIDS CORPORATION

PORT HURON MICHIGAN

A REAL WORK-MOVING

"Jack-of-all-jobs"

Paul Ehrhardt, Ehrhardt Welding Co., McKeesport, Pa., welds for Victory during the day... teaches welding at night on his Westinghouse All-purpose A-C Welder.

SAYS JOB SHOP OPERATOR OF HIS

A-C WELDER

Like most every other job shop operator, Paul Ehrhardt is swamped with jobs he never did before. Things people used to throw away, he now welds for further service . . . tractor cleats, sprockets, gears, housings, levers, lawn mower parts, etc. In addition, he fabricates parts for war industry, and at night teaches welding . . . a schedule that leaves no leeway for gadget-fussing or time out for maintenance. For that kind of service he switched to a-c welding.

From his Westinghouse All-purpose A-C Welder he gets the speed he needs—20% to 30% faster welding. He has no arc blow or maintenance to contend with, and he can turn out consistently better welds. Add to that, ample capacity for all types of job shop work, lower first and operating costs, simplicity of control, availability, and you have Mr. Ehrhardt's reasons for selecting the Westinghouse A-C Welder.

Before adding to or replacing present equipment in your shop, look into Westinghouse A-C Welders. Ask your Westinghouse Distributor or write for A-C Welding Booklet B-3136, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

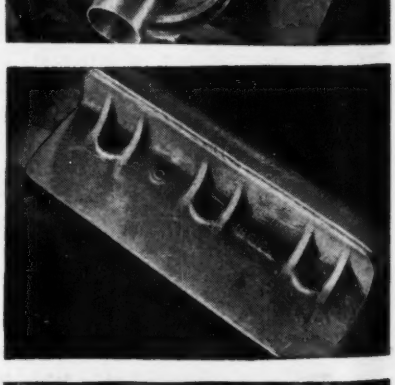
J-21279

EXAMPLE:

FABRICATES war products... makes vacuum-tight welds on housings for vacuum systems using Westinghouse DH and SW electrodes.

EXAMPLE:

MAINTAINS vital equipment. Hard-facing tractor cleats with Westinghouse Hardentough electrodes lengthens cleat life 3 to 5 times.



EXAMPLE:

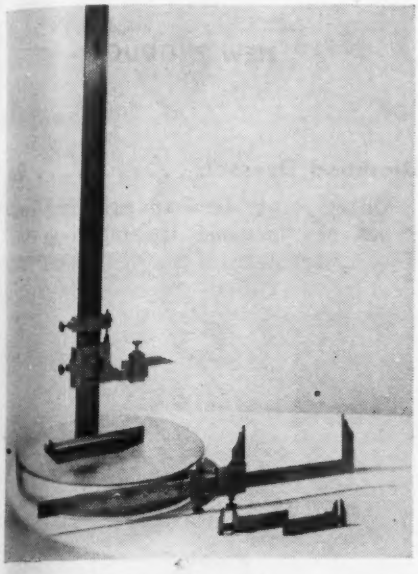
REPAIRS cast steel bulldozer drive sprockets. Break was burned out, pre-heated and welded with Westinghouse FP electrodes.

Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

A-C WELDERS

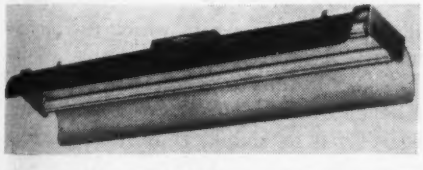
of flat. Designed for measuring inside and outside dimensions, vernier calipers come in 8, 12, and 24 in. sizes. Height



gages, with working surfaces lapped to within five wave lengths of flat, are available with capacities of 10, 18, 24, and 36 in.—AVIATION, *Aug.*, '43.

Fluorescent Reflector..... 92

Composition gloss-finished fluorescent lighting reflectors to conserve metals have been developed by **Bright Light Reflector Co.**, Brooklyn, N. Y., which is



offering two models—a two- or three-lamp 40 w. unit and a two-lamp 100 w. unit—for chain or rigid suspension.—AVIATION, *Aug.*, '43.

Wire Splicing..... 93

New line of Sta-Kon pressure splices has been announced by **Thomas & Betts Co.**, Elizabeth, N. J., for all aircraft wire sizes from No. 22 through No. 10. Splices are for joining circuits when various plane sections are brought together for final assembly. Twelve pounds pull disconnects the silver-plated fitting which, the manufacturer says, can be made or broken "innumerable times without affecting its working qualities." The diameter of the connection is no greater than the wire itself and can be insulated by drawing a piece of tubing over it.—AVIATION, *Aug.*, '43.

NEW PRODUCTS

Salt Bath Furnace..... 94

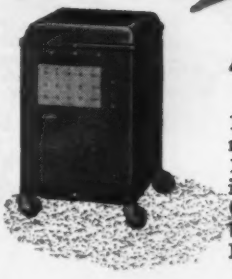
Upton Electric Furnace Div., Detroit, has patents pending on a new design of salt bath furnace designed to eliminate need for changing electrodes. Electrodes are sealed through sides of furnace below surface of salt where none of heated portion is exposed to air. Exposed sections of electrodes are cooled by water at tap temperature. Furnace can be built reasonably deep without increase in required area; one has been made 37 in. deep and 9x9 in., and solution only 4 in. deep can be used. Heat measuring control is supplied for temperatures from 1,200 to 2,500 deg. F. About 5 in. of salt is required to hold furnaces over.—AVIATION, *Aug.*, '43.

Milling Attachment..... 95

For making light cuts on its Bridgeport milling machines and thus saving the use of a horizontal boring mill, **Hoover Tool & Die Co.**, Detroit, is making the "Hoover-Riser," a gray iron casting recessed and drilled to fit this milling machine. Capacity is thus increased 6 in. Photo shows the device in use, providing clearance of 21½ in. for boring angled hole in a crankshaft.—AVIATION, *Aug.*, '43.

WESTINGHOUSE WELDERS FOR JOB SHOP WORK

4 ways to better welding

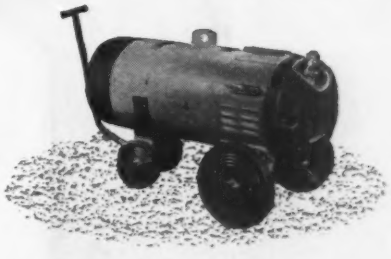


FOR SHOP MAINTENANCE AND LIGHT WORK

Model WT-1C—100 amperes. Current range, 20 to 140 amperes. Built-in capacitor (optional). Built-in breaker protection. Easy to move.

ALL-PURPOSE WELDER

Model WT-4C—200 amperes. 27-step current adjustment from 20 to 250 amperes permits using wide variety of electrodes. Built-in capacitor (optional) and Nofuze "De-ion" Circuit Breaker



NEW D-C WELDER WITH ARCONTROL

Single, pre-set current adjustment. Lots of capacity to handle all kinds of work. No drop-off after warming up. Simple adjustments. 200, 300 and 400-ampere models.

COMPLETE LINE OF WELDING ELECTRODES

Westinghouse electrodes are designed for fast production of high-quality welds with a-c or d-c on carbon steels, cast iron, stainless and alloy steels, sheet metal and special applications. Strike easily and have high deposition efficiency.

★ ★ ★

Write for latest a-c and d-c welding literature. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N. J-21279

Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

WELDERS

"Sub Sighted" DEMANDS QUICK ACTION!

Civilian boats at war are "poison" to lurking subs. Two-way radios, with batteries kept charged by Briggs & Stratton powered generators, flash signals that summon warships or planes for "the kill." One more service stripe for rugged, dependable Briggs & Stratton gasoline engines. Hundreds of thousands are now serving our armed forces through many standard and special applications.

To prevent unnecessary repairs and to save critical materials needed for war uses, it is vital that all Briggs & Stratton 4-cycle, air-cooled gasoline engine users (both military and civilian) provide systematic care to insure maximum efficiency and longer service.

Proper lubrication with the right oil is the No. 1 "must" of the 4-point Service Program which includes periodical inspection—keeping engines clean — and always properly adjusted . . . Keep your engines in top condition. Your nearest dealer or Briggs & Stratton Service Station will gladly help you.

BRIGGS & STRATTON CORP.
MILWAUKEE 1, WIS., U. S. A.

4 CYCLE
BRIGGS & STRATTON
GASOLINE ENGINES

Invest In Freedom—BUY WAR BONDS

NEW PRODUCTS

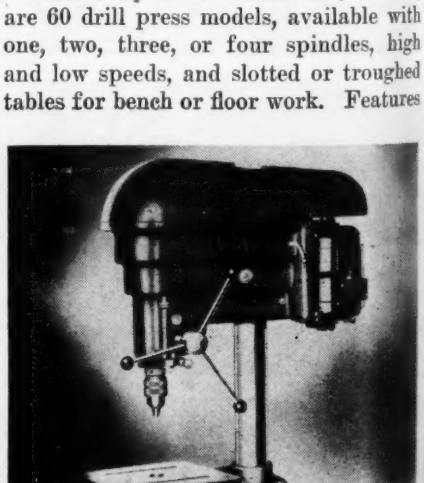
Diamond Dresser..... 96

Fitting most standard grinding machines, new diamond dressing tool consists of shank with recessed head set

screw for holding nib, which can be removed separately when shank is installed. Points, says the manufacturer, **Koebel Diamond Tool Co.**, Detroit, can be rotated in shank, thus insuring constant sharpness.—AVIATION, Aug., '43.

Drill Presses..... 97

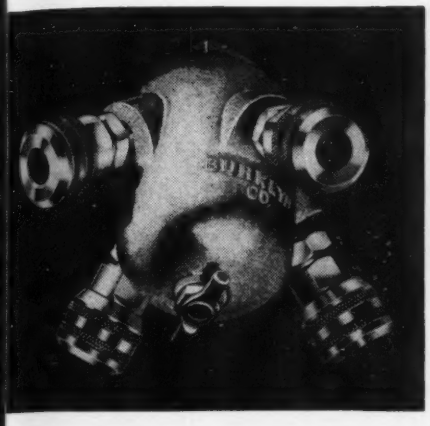
Offered by **Boice-Crane Co.**, Toledo, are 60 drill press models, available with one, two, three, or four spindles, high and low speeds, and slotted or troughed tables for bench or floor work. Features



are self-centering, 30-deg. pressure angle six-tooth involute spline and quill held by three bearings for drilling long holes. Two sizes of tapping machines, designed for use with drill press, operate at 3,000 rpm. in and 6,000 rpm out. —AVIATION, *Aug.*, '43.

Air Manifold 98

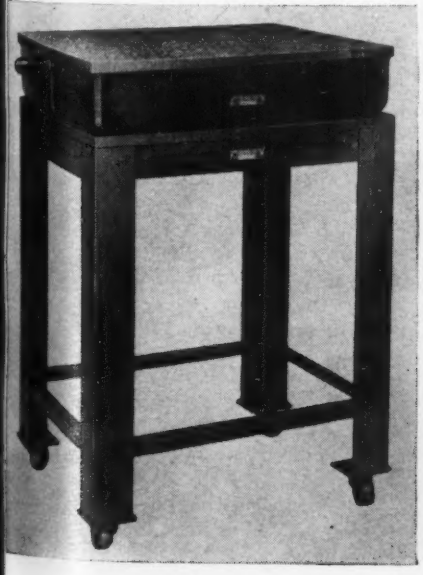
A new ceiling, suspension-type air manifold which accommodates up to four hoses is announced by the **Burklyn**

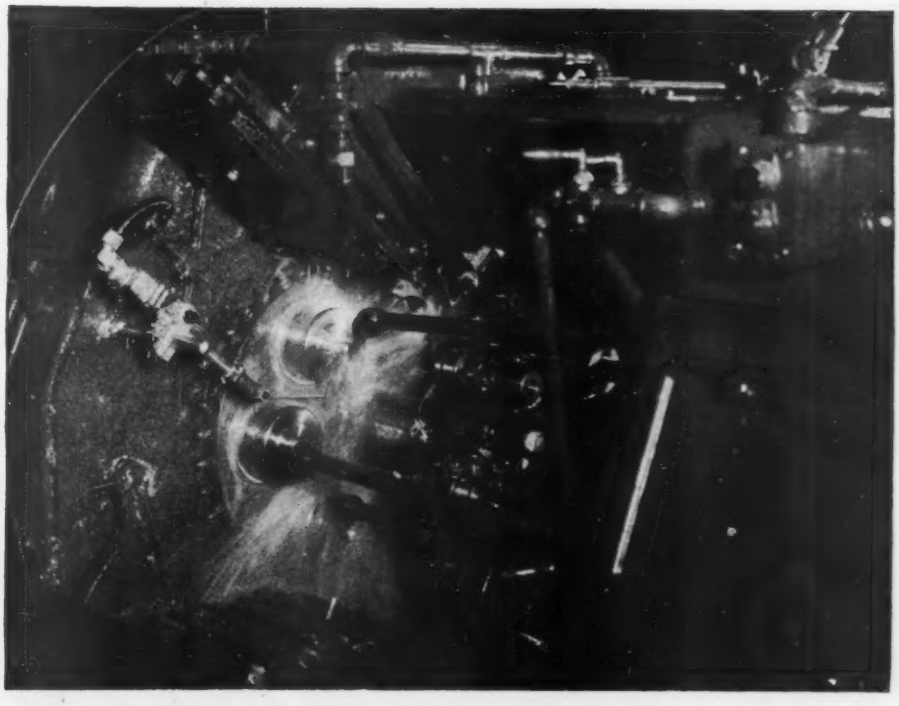


Co., Los Angeles, Calif. Usable with quick detachable hose fittings as illustrated or with straight screw-in connections, the intake has ½ in. pipe thread and the four outlets have ¼ in. thread. Body of the manifold serves as water trap and drain to reduce moisture reaching air tools and jet outlets.—AVIATION, *Aug*, '43.

Surface Plate Stand 99

Challenge Machinery Co., Grand Haven, Mich., has designed all-steel surface plate stand available with or without wheels. Produced in three sizes, 18x24, 24x24, and 24x36 in. for the company's surface plates, it can also be made for plates of other manufacturers. —AVIATION, *Aug.*, '43.



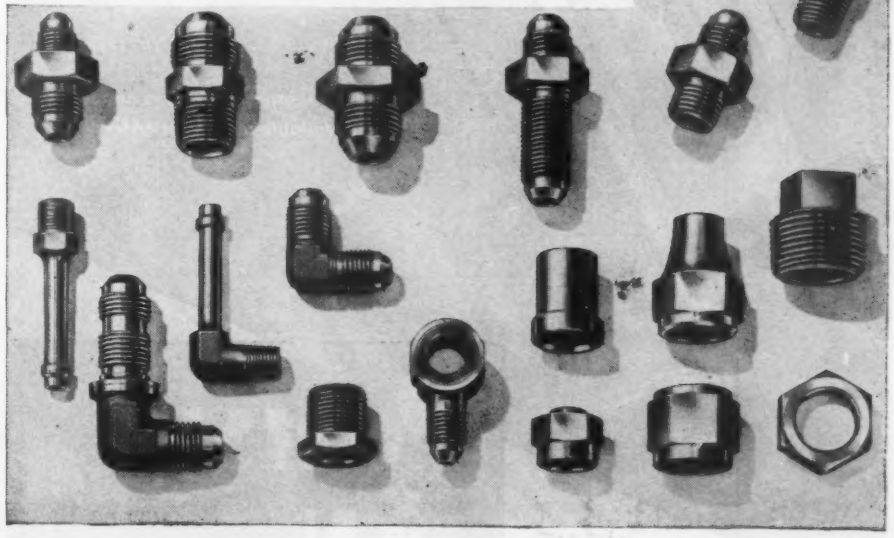


The "Know-How" and the Equipment to produce "AN" Standard Fittings

For well over 60 years Grinnell has been producing fittings for tubing and pipe in sizes from ⅛" to 24" diameter.

This "Know-How", plus up-to-the-minute production equipment, means the ability to turn out *precision* "AN" fittings in war-demand quantities.

We may be able to help you cut down assembly delays. Grinnell Company, Inc., Executive Offices, Providence, Rhode Island.



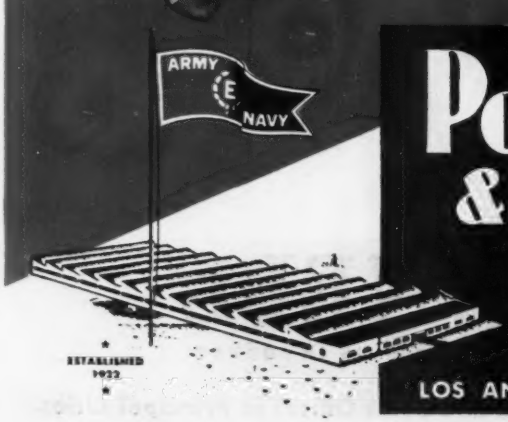
GRINNELL

WHENEVER PIPING IS INVOLVED

Plants, Branch Warehouses and Sales Offices in Principal Cities.

POULSEN & NARDON
new
SOCKETYPE
Cable Terminals
simplify swaging and double assembly production

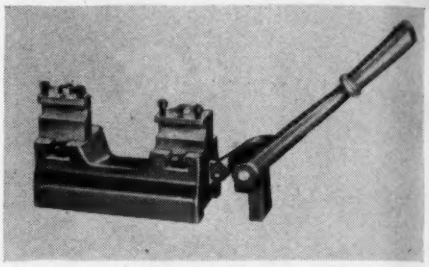
PN
5 Sizes in Both
Fork and Eye Types
(1/16" 3/32" 1/8" 5/32" 3/16" Cable Sizes)
Suitable for other cable sizes and types
Available on special order



POULSEN & NARDON, INC.
LOS ANGELES 11 · CALIFORNIA

Lathe Cross-Slide 100

Added to line of lathe attachments made by **Kessler Aero Tool Products**, Burbank, Calif., lever-operated cross-



slide for forming and cut-off work can be fitted into carriage dovetail of standard lathes without disturbing tool or carriage positions. Manufacturer reports that the device saves a high percent of the time required for hand-wheel method on same operation.—AVIATION, *Aug.*, '43.

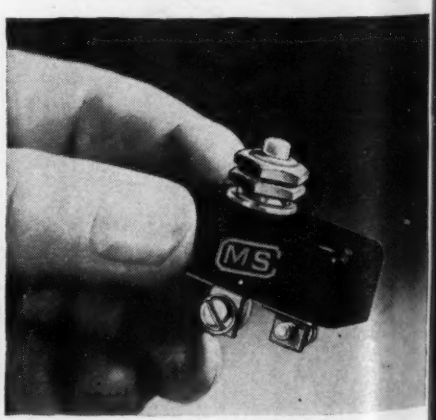
Tight-Space Wrench. 101

Heads angled at 15 and 60 deg. permit 24 bites on a nut within a circle with this wrench designed by **New Britain Machine Co.**, New Britain, Conn., for

use in spaces allowing movement of only an inch or two.—AVIATION, *Aug.*, '43.

"Peanut" Switch 102

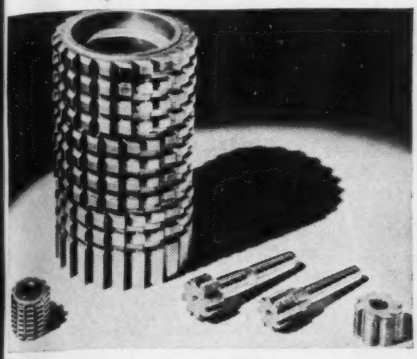
For electrical circuit control "peanut" micro switch made by **Micro Switch**



Corp., Freeport, Ill., is available with or without enclosing case, gaps up to .085 in.—AVIATION, *Aug.*, '43.

Milling Cutter 103

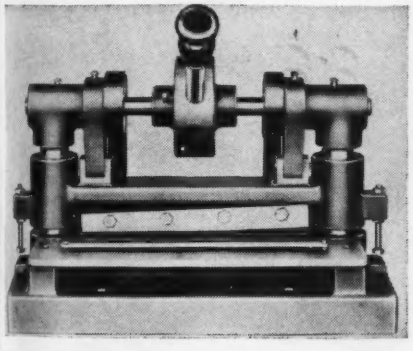
Multiple thread milling cutters, with or without tooth for removing imperfect



threads and with straight or spiral flutes, are being produced by **Plan-O-Mill Corp.**, Hazel Park, Mich., for any type thread miller.—AVIATION, *Aug.* '43.

Hand Shear..... 104

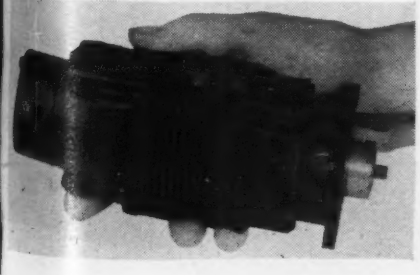
Shearing, slitting, squaring, stripping, and notching to tolerances of .001 in. in duplicating work on metals, plastics, and other materials are reported uses of this



shear. Blades can be reversed and will cut width of 9 in. in 22 gage steel plate, according to maker, **O'Neil-Irwin Mfg. Co.**, Minneapolis.—AVIATION, *Aug.*, '43.

Control Motor 105

Incorporating special clutch, small electric motor for operating remote controls in aircraft can, it is reported, be stopped from 8,000 rpm. in 1/50 sec. Manufacturer, **Lear Avia**, Piqua, Ohio, gives peak output as 9/10 hp.; weight is 5.56 lb.—AVIATION, *Aug.*, '43.



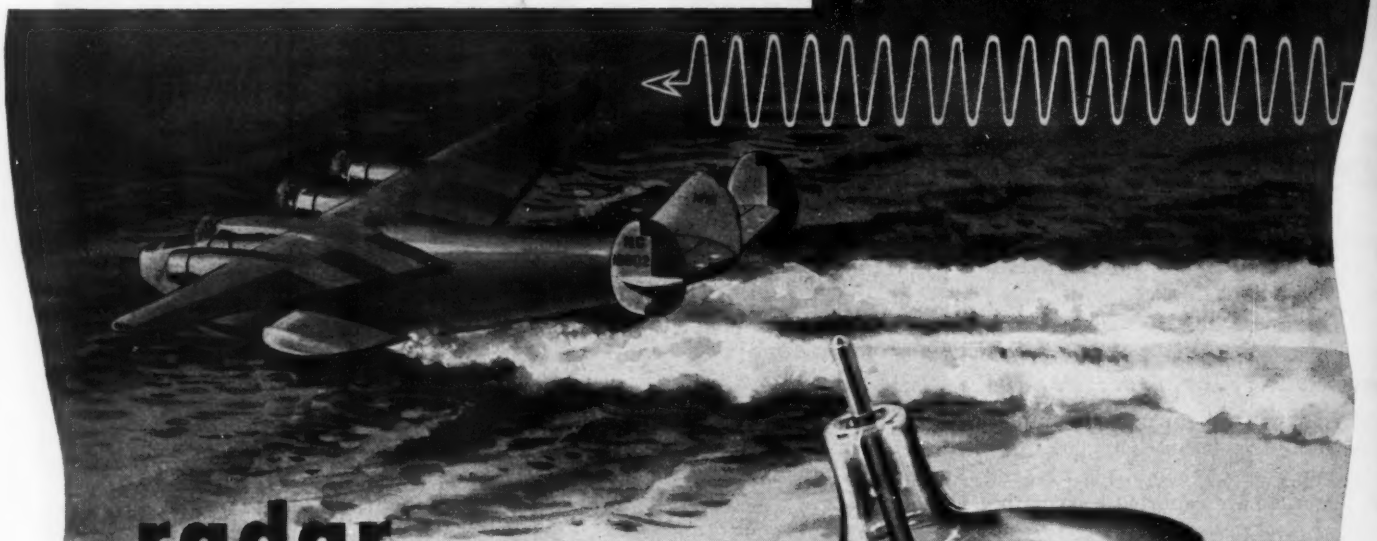
UNIONAIR Junction Box Assemblies are produced under a single responsibility — ours. In making them we use Junction Boxes made by Unionair, with years of acceptance by leading Aircraft Manufacturers behind them; Conduit Fittings made by Unionair, with 100% inspection by our own skilled staff and the approval of the scores of Aircraft Manufacturers that use them continuously, combined with our responsibility for all necessary component parts. These are all assembled into complete units by highly experienced personnel, backed by management with the know-how which comes from a background of accepting and meeting responsibility.

UNIONAIR

Makers of Junction Boxes and Assemblies
Conduit Fittings and Assemblies—Hydraulic Fittings

UNION AIRCRAFT PRODUCTS CORP.
NEW YORK

Another great contribution to the conquest of the air



radar and the electronic vacuum tube have scored a victory in man's conquest of the air. No longer need the pilot grope his way, no longer need fog and storm present so great a hazard to man's flight. Radar is an electronic device which by transmitting a rebounding beam enables one to virtually see through the darkness, storms and fog. Mid-air collisions, crashes into mountain sides, and other obstacles which may be in the path can be discerned miles ahead. Radar is probably the most important contribution to man's conquest of the air since the Wright brothers took off at Kitty Hawk. Vacuum tubes are the heart and soul of this equipment.

The usefulness of the airplane has been greatly advanced by the electronic vacuum tube. And Eimac tubes in particular have played an important role. First in airline ground stations, first in instrument landing devices and today first in military radar. Yes, Eimac tubes and Aviation are old friends. Out of this friendship comes a combined experience of great value to future progress.

EITEL-McCULLOUGH, INC. • SAN BRUNO, CALIFORNIA

Export Agents: FRAZAR & HANSEN
301 Clay Street, San Francisco, California, U.S.A.

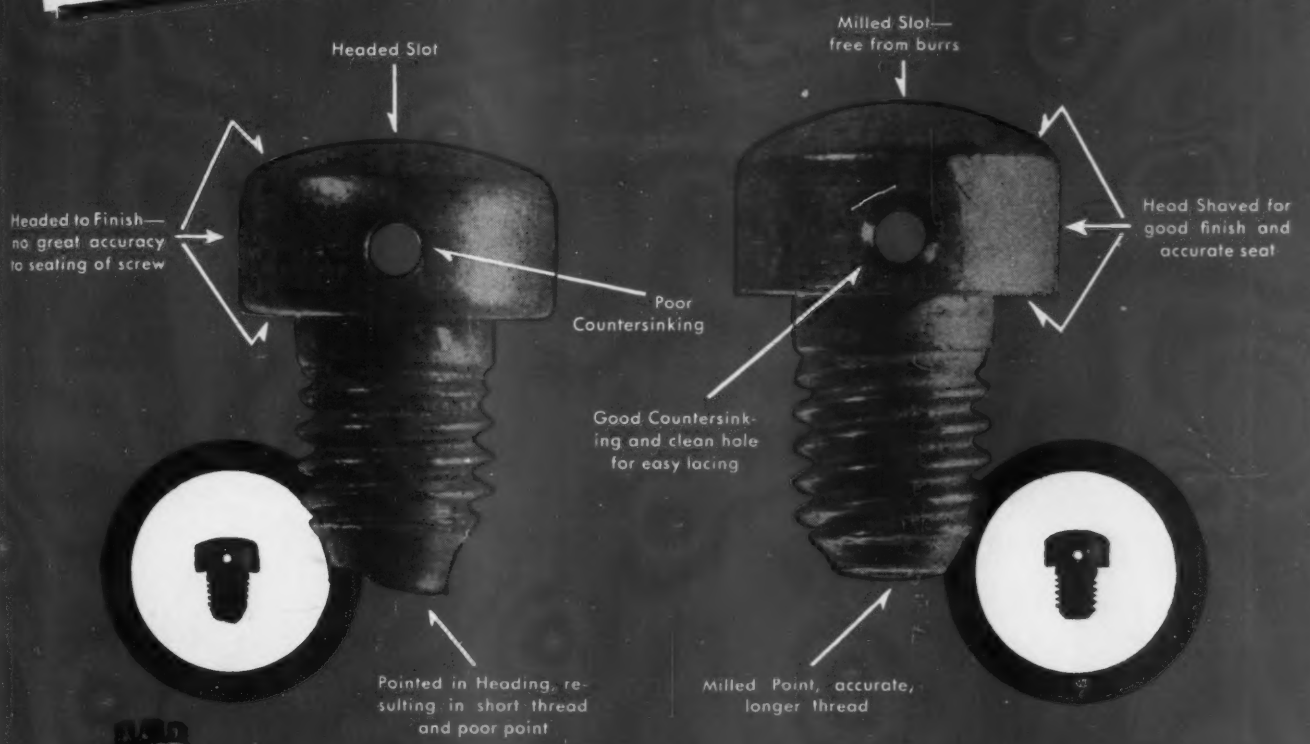
Follow the leaders to

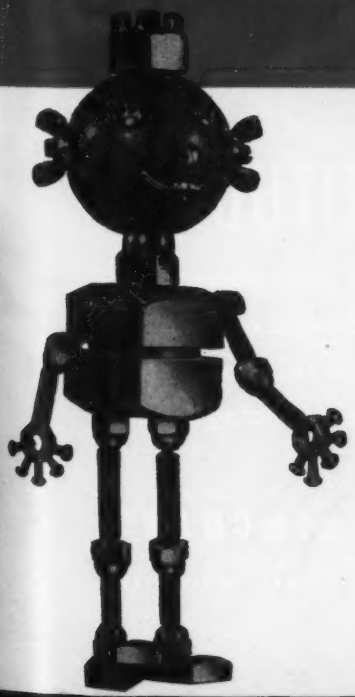
Eimac REG. U. S. PAT. OFF. **TUBES**

Eimac 304T tube

Screws ARE different!

AND IT'S THE MICROSCOPIC DIFFERENCES THAT COUNT IN AIRCRAFT WORK


Headed Slot
Milled Slot—free from burrs
Headed to Finish—no great accuracy to seating of screw
Head Shaved for good finish and accurate seat
Poor Countersinking
Good Countersinking and clean hole for easy lacing
Pointed in Heading, resulting in short thread and poor point
Milled Point, accurate, longer thread



A customer making aircraft complained about some screws and sent us a batch of them. One look and we saw that they were not ours. The contrast between the other screws and National's was striking.

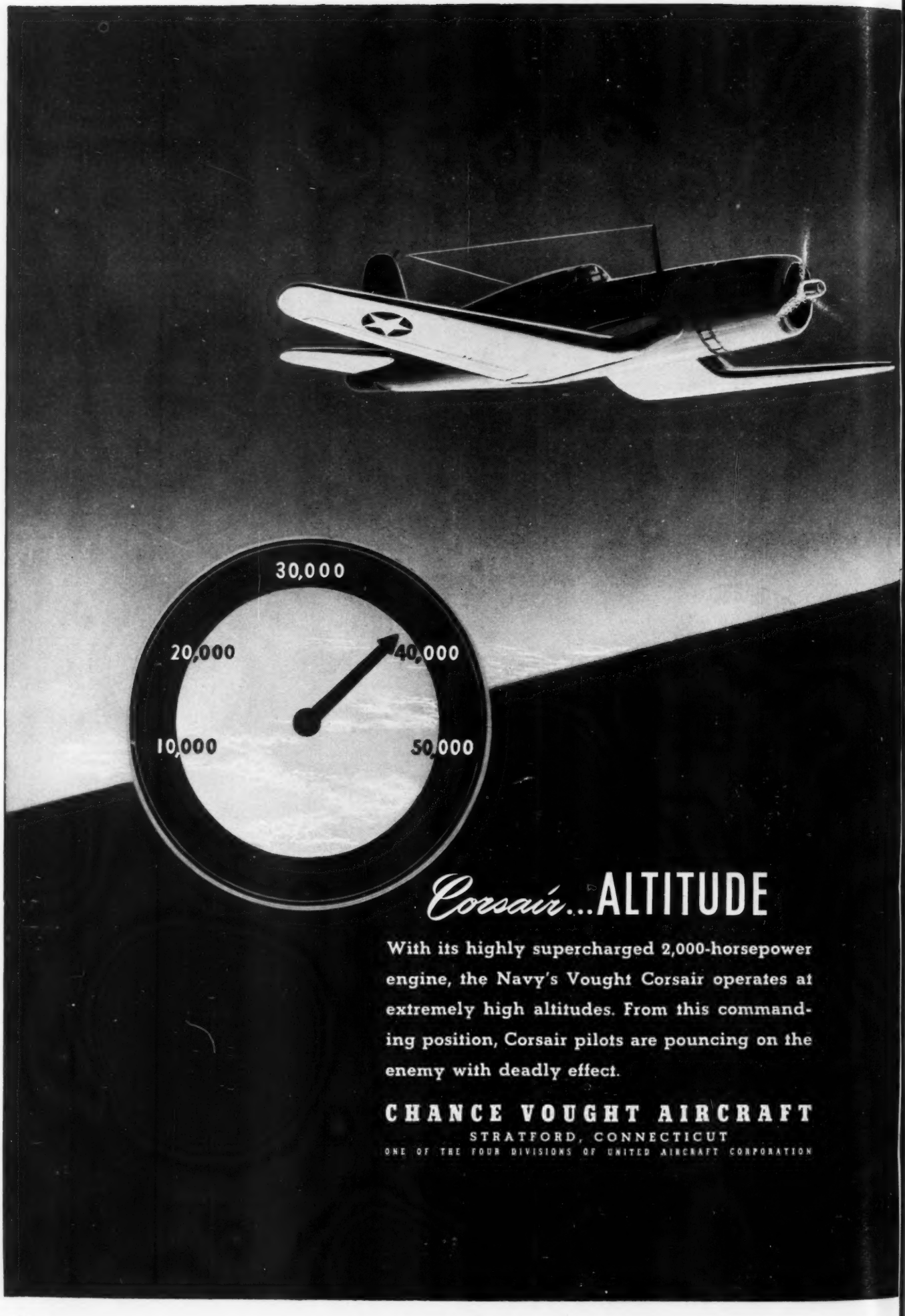
In order to make the difference clear we show above photographs of one of the screws made by ordinary production methods, and one of ours, together with actual magnifications of these same photographs.

The specifications called for AN screws with close tolerances, made of 4037 steel and heat treated. That's why methods commonly practiced for making competitive screws wouldn't do for this job.

National methods are stepped up to aircraft requirements.

National
HEADED AND THREADED PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND, O.


30,000
20,000
40,000
10,000
50,000
Corsair...ALTITUDE
With its highly supercharged 2,000-horsepower engine, the Navy's Vought Corsair operates at extremely high altitudes. From this commanding position, Corsair pilots are pouncing on the enemy with deadly effect.
CHANCE VOUGHT AIRCRAFT
STRATFORD, CONNECTICUT
ONE OF THE FOUR DIVISIONS OF UNITED AIRCRAFT CORPORATION

The AVIATION NEWS

BLAINE STUBBLEFIELD, Washington HERB POWELL, New York

Truman Report's Charges Kindle Disputes; Facts Not New, But May Undermine Morale

Washington (AVIATION Bureau)—The serious charges against the Army, Navy, and Curtiss-Wright Corp. by the Truman war investigating committee in its 30-page report are extremely involved.

The Army Air Force is blamed for ordering thousands of Curtiss-Wright P-40 fighters, planes which are called "second choice" at best and obsolescent when ordered. The report states that the AAF "at the Committee's recommendation agreed to eliminate production of P-40's." This indicates that the air command, in tapering off the P-40 program as newer designs were approved, relied on the Committee's judgment and not upon its own. But the Committee's claim that AAF commanders acted upon lay opinion in cutting back the P-40 program is called untrue.

C-W and all those opposed to the findings say that the P-40 was, and still is, a first-class all-purpose fighter. It was a proved plane when war was thrust upon us and our allies—when it was necessary to get into production immediately. Furthermore, it is said that the P-40 has run up a 10-to-1 score against the Japs and more than broken even in the Mediterranean. And Gen. Arnold, commander of the AAF, has announced that "it has shot down more ships than any other single fighter."

The Navy's plan to produce large numbers of the C-W SB2C *Helldiver* dive bomber, with construction of a plant at Columbus, Ohio, for the purpose, is called by the Committee a most unfortunate decision as a result of which "many tens of millions of dollars have been lost." The committee questions the Navy's judgment in selecting the SB2C for mass production when the Douglas SBD was giving satisfactory service. In fact, the Navy's entire dive bomber program is questioned in view of the Army's belief that such bombing is decreasingly effective against improved ground fire and air attack. Slow progress at Columbus and reputed failure to deliver any acceptable SB2C's up to the date of the report are severely criticized.

So involved are the elements of management, materials, labor supply, and luck in such a project that only a committee of aircraft producers would be competent to determine whether the company is at fault and to what extent. It is a fact that the Navy conferred several times with C-W in an effort to speed the SB2C development. The C-W management was changed, and in the end a major executive of the company took personal charge. Though the Navy certainly makes mistakes of military judgment, it is called presumptuous for the Committee, whose risk of error is many times greater, to question the Navy's judgment in public print. The Navy believes that difficulties with the SB2C can be overcome in a short time. Company officials say they feel that the plane may be on the point of outstanding success.

In this connection, it is well to recall the long difficulties experienced with some other new types. Everybody in the industry now knows that perfection of the P-38 was an arduous task. But the builders and the Army stuck to it. This development is cited by those opposing the Committee to show how difficult it often is to know when to abandon a troublesome project.

Most serious of all are the Committee's charges against the management of Wright Aeronautical Corp's. engine

(*Turn to page* 275)

"VENGEANCE" IN THE PACIFIC

Vultee "Vengeance" two-place dive and attack bombers, adapted for the Army from a design drawn up for the Navy, have now been reported in action in the Southwest Pacific. The planes have a span of 48 ft. and length of 40 ft. and mount the 1,700 hp. Wright "Cyclone". Range is about 1,200 mi. "Vengeance" pilots in the first announced action were Australians.

Five New Plane Types Named in Truman Report

First public mention of five new combat craft, hitherto on the restricted list, has been made in the Truman Committee's report on the aircraft industry.

In the section bearing on Navy dive bombers the report reveals that "an improved version of the Douglas SBD is being built. It will be known as the Douglas SB2D. The Navy reports that it is expected to be a splendid plane of high performance." In the section on Navy carrier torpedo bombers and fighters the report states that Grumman has developed a new fighter, the F6F, "popularly referred to as the *Hellcat*, which is capable of exceptional performance." Also in this section, the report reveals that "Vultee, in Allentown, Pa., is making the TBV, a Vought Sikorsky torpedo bomber."

Reviewing Army craft, the report states that "the Douglas A-26 is an improved version of the *Havoc*, one of the best-liked planes that has been built in this country." The report disclosed that the Northrop P-61 "was intended for use as a night fighter."

Damon Resigns; Marchev New Republic President

Ralph S. Damon, president of Republic Aviation Corp., Farmingdale, N. Y., since May 1, 1941, has submitted his resignation effective Aug. 31, according to an announcement by W. Wallace Kellett, chairman of the company's board. Subject to approval of CAB, Mr. Damon will continue for the present to serve on the Republic board and will act as consultant without fee.

Succeeding to the presidency is Alfred Marchev, who has been with the company since Feb., 1942, successively as assistant to the president, vice-president and, beginning last June 1, as director of all Republic operations.

Mr. Damon has been on leave from the presidency of American Airlines to assist in starting production of the P-47 *Thunderbolt*, now being built in Farmingdale and Evansville, Ind., in quantities meeting AAF schedules. It was subsequently announced by American that Mr. Damon would return to the company as vice-president and general manager on Sept. 1.

Last "Hudson" Off Line

After unbroken production for half a decade, the last of the celebrated Hudson bombers — known affectionately as "Old Boomerangs" because of their ability to hit and come back—came off the Lockheed assembly line on June 20. The facilities have now been given over to augmented schedules on the *Constellation*.

Foreign Policy, Applications, Lea Bill to Fore As Manufacturers State Position on Control

Washington (AVIATION Bureau) — Simultaneous consideration this fall of three important aviation issues is likely to set off debate and possibly confusion that may last well into the winter.

On the autumn schedule in Washington are issuance of a report by the Interdepartmental Committee on International Aviation, hearings by CAB on a score of certificate applications by domestic airlines, and hearings in Congress on Rep. Clarence Lea's bill revising the Civil Aeronautics Act and creating an independent civil aeronautics commission.

Revision of the law and the decisions reported by the Interdepartmental Committee will automatically intertwine, for the domestic program of the Lea bill will have to be coordinated with the foreign policy outlined by ICIA.

This policy will probably be outlined next month at an Anglo-American conference in Washington. It is expected that the committee will advocate free flight by non-military planes over specified international routes and freedom from monopoly while opposing special favors and government ownership. Forty manufacturers have also gone on record against the latter possibility. "The government," they say, "should not own, financially control, or manage any United States flag carriers engaged in domestic or international operations."

Replying to CAB's questionnaire on postwar aviation, the manufacturers came out for government negotiation with other countries concerning international operations, equal opportunity, and operating and commercial rights for U. S. carriers. Further, they endorsed subsidies where necessary to meet foreign competition, international conferences and agreements to establish world-wide safety standards and to encourage inter-country personal flying, salvage, and conversion of surplus potential transports by their makers for sale or loan to U. S. and foreign operators. They also stated they approved encouragement of postwar plans by manufacturers who should begin experimental work as soon as military orders decline.

The manufacturers likewise went on record against artificial restriction of air traffic and dumping of military planes.

Meanwhile, Congressional action on the Lea bill, H. R. 1012, cannot be expected until fall and could be delayed into next year by potent conflicting interests. For example, the President himself is said to have objected to the provision which would remove the Civil Aeronautics Administration from jurisdiction of the Department of Commerce. Jesse Jones, Secretary of Commerce, also has disapproved. The railroads and political interests have stalled the committee again and again, demanding rewrites of this and that, and the result is that the provision against multiple taxation is now a paragraph of soft words meaning nothing. Federal zoning of port areas also is compromised with state and local authority, but CAB still holds a weapon in authority to stop interstate operations on ports where dangers exist. Extensive concessions are made to military aviation.

British Combine

NEW U. S. AIRCRAFT INSIGNIA

Officer stands beside AAF plane bearing new insignia of Army and Navy craft in all theatres of action. Two white rectangles have been extended from either side of the familiar white-star-on-blue-field and the entire device has been circumscribed by a red border. Visibility is said to be increased 60 percent.

What the opposition is really driving at is elimination of Section 408, which says that surface transportation shall not gain control of airlines. Shipping, automotive, and rail men are all driving at that objective, and they will stall the bill as long as they can, knowing it would be easier to defeat it now than to reopen the issue later.

Controversy Expected On Surplus Disposal Bill

Washington (AVIATION Bureau)—Extended controversy is expected this fall over Rep. Clarence Lea's bill, H.R. 2959, which provides that CAB be authorized to dispose of postwar surplus planes.

Already some men in the industry have objected to the proposed appointment by the Board of an "executive director" to handle the liquidation on the ground that he would have dictatorial powers. To others this fear seems unfounded. Another complaint is that such a program would lead to similar single-industry plans for other categories—automobiles, ships, trucks, machine tools, etc.

But since the problem of surpluses affects the whole nation on a vast scale, there will accordingly be over-all liquidation schemes and a consequent effort by some leaders to prevent aviation from having a program of its own.

Aircraft manufacturers naturally want to be represented on any agency charged with disposals. But at present they are without adequate voice. The Aeronautical Chamber of Commerce is relatively inactive for the duration, and the by-laws of the Aircraft War Production Councils forbid member participation in politics. The Councils, however, are preparing to modify this self-imposed prohibition.

One-Third of War Dept's $71 Billion for Aviation

Approximately one-third of the $71,500,000,000 War Department appropriation bill signed by Pres. Roosevelt for the next fiscal year will be used for aviation.

AAF receives $23,655,481,000 of which $20,203,843,736 is to be used to buy some 100,000 planes—36,000 bombers, 38,000 fighters, 12,000 transports, and 9,000 trainers. Covered by the remainder of the appropriation are funds for 900 airfields and for 273 groups involving 2,500,000 officers and men. Training will be given 300,000 technicians, 80,000 pilots, 12,000 bombardiers, and 18,000 avigators.

Included in the War Department appropriation and those for the Navy and departments of State, Commerce, and Justice was an item of $82,973,000 for the War Training Service. The Commerce Department bill also carried $58,297,000 for CAA and $1,226,000 for CAB. The CAA fund was broken down into general administration, $1,800,000; establishment of avigation facilities, $4,100,000; maintenance and operation of avigation facilities, $19,650,000; technical development, $542,000; enforcement of safety regulations, $2,300,000; maintenance and operation of the Washington National Airport, $505,000.

The CAB section of the bill also reappropriated the unexpended balance of funds made available a year ago for development of landing areas. The original amount for this purpose was $199,000,000, and estimates were that about $99,000,000 had not yet been spent.

Truman Investigating Foreign Airfield Deal

In the wake of charges that hundreds of airfields built abroad by the American military are scheduled to go part and parcel to the respective foreign countries where they are located, two members of the Truman Committee are on an unofficial trip with Sens. Russell, Lodge, and Chandler to assess the situation.

Sens. Mead and Brewster of the Committee plan to make an "on the spot" check of foreign airport agreements and U. S. military and potential civilian activities abroad. They hope to return with recommendations which will implement a more satisfactory policy. It is possible that they may issue a public report of their findings.

Mead and Brewster have conferred with Army and Navy officers and BEW and lend-lease officials in the course of drafting the basis for their investigations. "It is our understanding that if there is anything in lend-lease in reverse," announced Sen. Mead, "we certainly should have some concessions which would permit our commercial planes to land on the fields and to use their facilities in the postwar era."

Joseph Sweetman Ames

After 24 yr. of service on the National Advisory Committee for Aeronautics, from which he retired in 1939, Dr. Joseph Sweetman Ames passed away in Baltimore on June 24.

One of the original members appointed to NACA in 1915 by Pres. Wilson, Dr.

Gliders Surprise Sicily

First comprehensive use of gliders in this war was during the British and American attack on Sicily. And the Nazis were surprised by a technique that they had earlier used in "proto" form against the British, notably in Crete.

There will be more points from which the Allies can use gliders against Hitler's Europe. Meanwhile, there are still differences of opinion whether glider troops have worthwhile advantages over paratroops. At present gliders cannot be recovered after combat use.

Ames, onetime physics professor and president of Johns Hopkins University, served as chairman of the NACA executive committee from 1919 to 1936, as chairman of the main committee from 1927 to his retirement, and at different times on more than 20 subcommittees.

The Committee's $16,000,000 research laboratory at Moffett Field, Calif., has been named in his honor. "When aeronautical science was struggling to discover its fundamentals," said a Committee resolution adopted when Dr. Ames retired, "his was the vision that saw the need for novel research facilities and for organized and sustained prosecution of scientific laboratory research."

Don H. Walker

News has been received of the death of Capt. Don H. Walker, veteran aerial cartographer and commander of the 1st Mapping Squadron, AAF. He had been one of the country's outstanding autogiro pilots and a leader in the gathering of news by plane. A heart ailment caused his passing.

★ SPOT CHECKING ★

Big part being played by the new North American A-36 in the current Mediterranean offensive deserves a special page in the record book. Fighter-boomber version of the P-51 **Mustang,** it pepped the reduction of Pantelleria, then went on to star in the Sicily assault.

At press time, airline traffic and advertising executives were gathering at Denver for the annual Air Traffic Conference, with Continental Air Lines as host. Both wartime and postwar problems were on the agenda.

Also underway was the CAA's annual air traffic control and communications conference at Chicago, scheduled to consider traffic needs and urge global standardizations. To be highlighted, too, was postwar installation of automatic traffic control systems in the New York, Washington, Ohio, Chicago, and California areas.

To meet employment needs, PAA has opened a central personnel procurement office in Miami.

Contract for a $2,000,000 high-pressure wind tunnel has been let by the NACA to the Pittsburgh-Des Moines Steel Co. Fourteenth erected or on order from the firm, this tunnel is to be built at Ames Aeronautical Laboratory, Moffett Field, Calif.

Founded by World War I flyers who remained in the service, the Order of Daedalians, organized at Maxwell Field in '33, is now open to every "First Fuss" pilot who won his wings prior to Nov. 11, '18. Daedalian Wing Commander, Col. C. H. Dowman (Room 4C-270, Pentagon Bldg., Washington, D. C.), invites affiliation by all eligible veteran airmen of the other war.

Radio talks dealing with present and future vital interests of American aviation are being delivered by CAB Chairman L. Welch Pogue in the course of a transcontinental swing. Accented is the role of the President's Interdepartmental Committee for International Aviation.

Tenth anniversary of Chicago & Southern Air Lines was recently marked in Washington at a dinner given by the NAA.

Too large to go through a freight car door, a mammoth vertical fin was recently lashed under the belly of a Curtiss-Wright **Commando** and flown from Buffalo to Miami.

With the addition of several new factory buildings, now under construction, Ryan's plant at Lindberg Field will cover 38 acres. Included is a large final assembly structure to meet increased schedules.

The Washington Windsock

By BLAINE STUBBLEFIELD

You're not in the swim if you're not building, or at least designing, a helicopter. At last count, some 25 reputable, and some not so reputable, firms were so engaged.

The hottest spot in aviation some day will be occupied by the administrator charged with the equitable liquidation and distribution of government-owned airplanes. It will be hard to find a man who is both foolish enough to try it and smart enough to do it.

Pressurizing of warplane cabins, started seriously a couple of years ago, is still not satisfactory. But we can report that some ingenious improvements have now been worked out for new planes.

Although the Department of Commerce has predicted a brilliant aviation future for New York, the great world air terminals will not necessarily be the great shipping points of today. It is easy to forget that shorelines mean nothing to airplanes. So Omaha and St. Louis may have their express trips non-stop to London.

Not all aviation leaders realize what a huge bear they have by the tail. The business is going to throw a lot of people who don't know how to ride. CAB, housed by the Department of Commerce, and CAA, actually a subsidiary of Commerce and no longer a front-line agency, are not considered to be in a prime position to handle international affairs of the first magnitude. Now, however, Congressman Clarence Lea and others on the Hill are preparing to legislate these civil aviation authorities into first class positions. If they do not succeed, a new agency, or agencies, will be set up.

For months civil aeronautics officials have felt that the Army had not made the best use of those transport planes needed to prevent open failure of the airmail system. But they haven't got the standing in Washington to howl and be heard. Their position was deprecated by the Administration, submerged in government reorganizations, and weakened by expedient appointments. The power to reinstate control of civil aviation rests with Congress.

Silence is gold—or even copper. Airlines which *didn't* file applications for postwar routes the world 'round are giving themselves a pat on the back—for CAB says the date of filing will not be considered in final decisions. The early birds have shown their cards; the others can now take their time and watch how the wind blows.

★ Military Memos ★

Our 8th Air Force scored better than 4 to 1 against enemy planes in its first year of operation, concluded July 4. A confirmed total of 1,199 Axis craft were downed against a loss of 276 American bombers as the 8th flew 68 daylight raids numbering 7,067 sorties. All told, 11,423 tons of bombs were dropped on 102 different targets.

The old Technical Training and Flying Training commands have now been combined into a single command, with Maj. Gen. Yount, chief of the former FTC, as director. In 2¼ yr. of operation, the TTC has trained upwards of 500,000 AAF technicians.

Successful air evacuation of more than 50,000 sick and wounded men from the various battle fronts has resulted in the designation of Bowman Field's AAF school of air evacuation as a permanent unit, with expansion of the program planned.

First half of '43 saw addition of 9,000 planes by our Navy, and 70 percent of the June production of aircraft for the sea arm comprised combat types.

Training is now in full swing at the new $10,000,000 naval air station at Ottumwa, Iowa.

Military maps covering more than 1,600,000 sq. mi. of the earth, including vast expanses in Africa, Asia, Alaska, and South America, have been pieced together from the wealth of aerial photos snapped by the AAF. The regions detailed total more than 35 times the area of Pennsylvania.

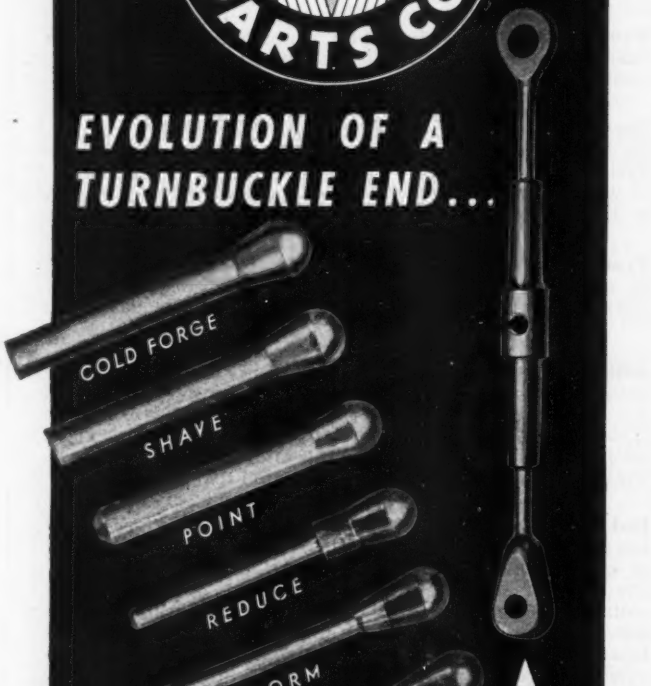
There are more than 1,000 battle-front veterans serving as instructors in the 2nd Air Force alone.

Loftiest bail-out made in this country was jotted into the books June 24 by Col. W. R. Lovelace, 2nd, AAF expert on high altitude equipment. To test protective paraphernalia, he took to the silk at 40,200 ft. and landed 23 min. 51 sec. later, "almost exactly" the elapsed time pre-calculated in the laboratory.

So many Nazi locomotives have been plugged by Allied airmen that the Germans have taken to mounting A-A guns on their trains.

AIRCRAFT Standard PARTS CO.

EVOLUTION OF A TURNBUCKLE END...



THE "AIRCRAFT STANDARD PARTS" WAY

The first step shown above is the key to why Aircraft Standard Parts turnbuckles are better and stronger. Note that our turnbuckle ends are machined from *forgings*, providing not only economy of material and machining time, but also assuring proper distribution of grain structure in the material to assure maximum strength through proper stress distribution. Available in a wide variety of standard types and sizes. Write for special bulletin on "Aircraft Turnbuckles."

AIRCRAFT STANDARD PARTS CO.

1711 19th Ave., Rockford, Illinois

Supplementary Reply to CAB Questionnaire Advocates Competition on Foreign Routes

Washington (AVIATION Bureau)—Eighteen U. S. airlines have held a five-day closed meeting here and released a supplementary formal reply to the questions recently circulated by the Civil Aeronautics Board in cooperation with the President's interdepartmental foreign aviation planning committee.

In substance, the lines asked for a world-wide air system operating on a competitive basis like the domestic system. This proposal was made under five main headings: (1) Free and open competition subject to reasonable regulation by appropriate governmental agencies; (2) private ownership and management; (3) fostering and encouragement by the government of a world-wide air transport system; (4) freedom of transit in peaceful flight; (5) acquisition of civil and commercial outlets required in the public interest.

Pan American Airways, which has exclusive contracts for international service with about 40 nations, was not represented at the meeting. A telegram, sent by PAA but not read publicly, was understood to say that this company would comment after reading the proposal. Aviation observers here say that PAA is advocating a single U. S. foreign service. Also absent from the meeting were American Export and United. The latter is also studying the statement. So far, it was said, United "had not committed themselves in a manner acceptable to the other carriers."

The Air Transport Assn. made no statement, but its office said that the proposal under consideration was not within its scope.

Of U. S.-built airports in foreign lands, the airline presidents said, "Even though sovereign rights over such facilities may rest with the nations in which they are located, the right of transit and commercial rights should be reserved for U. S. carriers."

Undoubtedly these proposals and many others will be considered by the administration and by Congress, both of which will seek a share in formulating the foreign program.

Calling Names

A. M. Wibel, former v.-p. and director of Ford Motor, has joined Nash-Kelvinator as v.-p.

Vernon Mixter, a sheet metal supervisor at Glenn L. Martin, started building plane models when he was eight. Since then he has compiled an amazing record at various shows. Among his collection is a Martin B-26 Marauder model, with two .23 cu.-in. gasoline engines, which has been clocked at a record speed of nearly 100 m.p.h.

Hans Lasker, factory manager at Republic Aviation, and **Henry MacDonald,** asst. factory manager, have been promoted to the newly-created works manager posts, Mr. Lasker at the Long Island Plant and Mr. MacDonald at Indiana. **Irving Keough,** former gen. supt., becomes factory manager, while **Donald Gutch** moves up as gen. supt. and **Chester Kucyn** becomes production manager.

Charles Sardou, Jr., has been promoted to the post of chief draftsman of Consolidated Vultee. He is succeeded as standards engineer by **Ed Pinger.**

Denis McCormack, for the past 11 yr. manager of the commercial and flight instruments department of Julien P. Friez leaves to become general manager of Fox Munitions.

Edgar S. Hutton has been elected treasurer of Chambersburg Engineering, succeeding **S. L. Peterman, Jr.**

Almo O. Bearden, for 10 yr. section supt. of the Pan American base at Port of Spain, Trinidad, has returned to the U. S. for reassignment.

William P. Woodside has resigned as v.-p. in charge of research for Climax Molybdenum.

Jacqueline Cochran has been appointed director of women pilots in the AAF and special assistant to **Maj. Gen. Barney M. Giles.** Mrs. **Nancy Love** has been assigned as an executive to the staff of **Col. William H. Tunner,** commanding officer of the ferrying division, ATC.

Chicago & Southern Air Lines having established a new department to handle postwar research and planning, has named **W. C. Burks,** Chicago district traffic manager, as director of the new department.

At Westinghouse Electric & Mfg. Co., **R. W. Gemmell** has been named manager of the aviation section, industry engineering dept., and **W. A. Mechesney,** manager of the aviation section under the industrial department.

E. E. Lothrop has been appointed to the new Sperry Gyroscope position of asst. to general sales manager, general staff, and he will be responsible for conducting market analyses as assigned.

Capt. Eddie Rickenbacker has been awarded an honorary degree of doctor of humane letters by the University Foundation and American Theological Seminary.

Carl Winstead, Cessna Aircraft test pilot, now has 10,000 flying hours in his log book. At the time the 10,000th hour clicked over, he was test flying the Cessna Loadmaster, new cargo carrier.

E. R. Doak, president of Doak Aircraft, announces that new

officials have been elected to the board of directors, among whom are **Nelson E. Grace**, sr. v.-p. and factory manager, and **Leonard Comegys**, attorney. New appointments as v.-p.'s are **Stephen F. Hinchcliffe**, in charge of sales, and **Eldore E. Rosier**, in charge of contracts. **Jack McFall** is the new director of training and **Banning Garrett** is asst. industrial relations director of the company.

Elmer L. Sutherland has been elected V.-P. of Aeronca Aircraft.

Warner Jones, formerly asst. mgr. of Consolidated Vultee's Pennsylvania division, has been appointed division manager of the company's Kentucky modification center.

Charles Hummel is now comptroller of Bendix Aviation, succeeding **W. H. Houghton**, recently elected treasurer.

AWA Holds 5th Meeting

Represented by 94 of its 144 members, the Aviation Writers Assn. held its fifth annual national convention in New York City June 25-27. Elections saw Wayne W. Parish, editor and publisher of *American Aviation*, named president, succeeding Sloan Taylor, aviation editor of New York's *Daily News*.

Truman Report

(*Continued from page* 271)

plant at Lockland, Ohio. Briefly, the Committee contends that Lockland management, in collusion with AAF inspection officers, falsified tests, destroyed records, forged inspection reports, failed to segregate substandard materials, and changed allowable tolerances. In other words, a group of citizens and soldiers, mostly in mutual agreement, are accused of causing production of substandard engines, knowing that lives and combat engagements might be lost as a result.

The Army's Board of Investigation says there is "no question but that careless inspection existed throughout the plant. Added to this was the limited training and lack of experience of inspectors ... and efforts of the company to meet an ever-increasing ... schedule." The company's spokesmen admit that the Committee has a collection of records which seem to prove the charges. But, as a matter of fact, they say, it is the old question of how much judgment shall be used by inspectors—how far they shall be allowed to depart from the specifications. As for "fixed" records, there were times, they admit, when Joe Smith was absent and Suzie Jones signed for him; but there was never any intent to falsify or defraud.

Recalled are the Committee's recent charges against Carnegie Illinois Steel for delivering substandard ship plate to the Navy and the Maritime Commission. The charges were found to be true; superintendents were cutting corners to get out more steel. But in the end both the Army and Navy stated publicly that the deviations were of no importance, that they would have taken the steel anyway.

Out of the mass of conflicting claims, however, these facts stand out clearly: The Army, in its report, states that engines shipped from Lockland during the period of alleged faulty inspection compared favorably with other types. While the Army Board did find unsafe material in engines ready to be shipped, it found no evidence the management had encouraged its use. There is no evidence anywhere that Lockland engines failed more often in action than any other engines of their type.

The company feels that it will be exonerated in Federal District Court where suit has been brought against the engine division. But meanwhile, thousands of hours of the time of men badly needed in the war effort will be used up in additional hearings.

Criticism is also leveled by the Committee against the Army and the Glenn Martin Co. for continuing production of the B-26 medium bomber which is called unsafe except in the hands of specially trained pilots and said to cost too much to produce and maintain, although it is "an exceptionally fine plane in the air." Martin's *Mars*, of which the Navy has ordered 20, "has not been put to any important practical use," the report says. Since the services, not the manufacturers, approve airplane designs, these criticisms fall upon them and not upon the Martin company. Nevertheless, Mr. Martin points out that his planes are doing creditable work in combat.

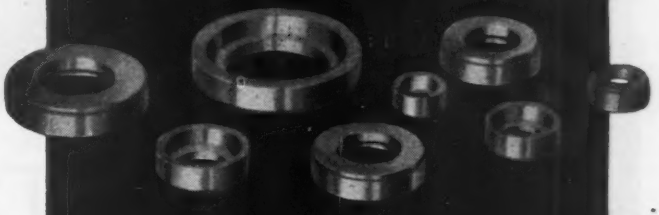
There is no new information in the report for the Army, the Navy, or the industry. All conditions criticized were known, and decisions were taken on them—long ago. Therefore, opponents say, publication served only to make headlines for the Committee. It can be said, though, that the report gave the public assurance that its war leaders and manufacturers are being watched by Congress.

On the other hand, observers point out that P-40's and B-26's and perhaps SB2C's will be in production for many months, and perhaps they will be flown for the duration of the war.

The report is bound to undermine confidence of the pilots who will fly them, and especially of the workers who build them.

THREADED TAPER PINS

High-strength nickel steel taper pins, generally used in aircraft construction. Used with special washer (see below) and a thin slotted or self-locking nut. Ordinarily furnished drilled with cotter pin hole. Made of WD2330 nickel steel in accordance with Army-Navy Specification AN-QQ-S-629. Centerless ground after hardening, and cadmium plated.



TAPER PIN WASHERS

Ordinarily, these are a screw machine product, but ours are stamped. Thus we are able to provide accurate, uniform washers with prompt delivery and at lower cost. Compare our prices! Made from high quality steel and cadmium plated to Army-Navy Specification AN-QQ-P-421. *Sizes to fit all popular taper pins in stock. Four weeks delivery on sizes not in stock.*

We are Specialists . . .

in the manufacture of selected items of aircraft hardware. In addition to the above, we can furnish high-quality Drilled Head Aircraft Bolts, Drilled Fillister Head Machine Screws, Hexagon Head Bolts, Clevis Bolts and Pins, Washer Head Screws and Precision Studs.

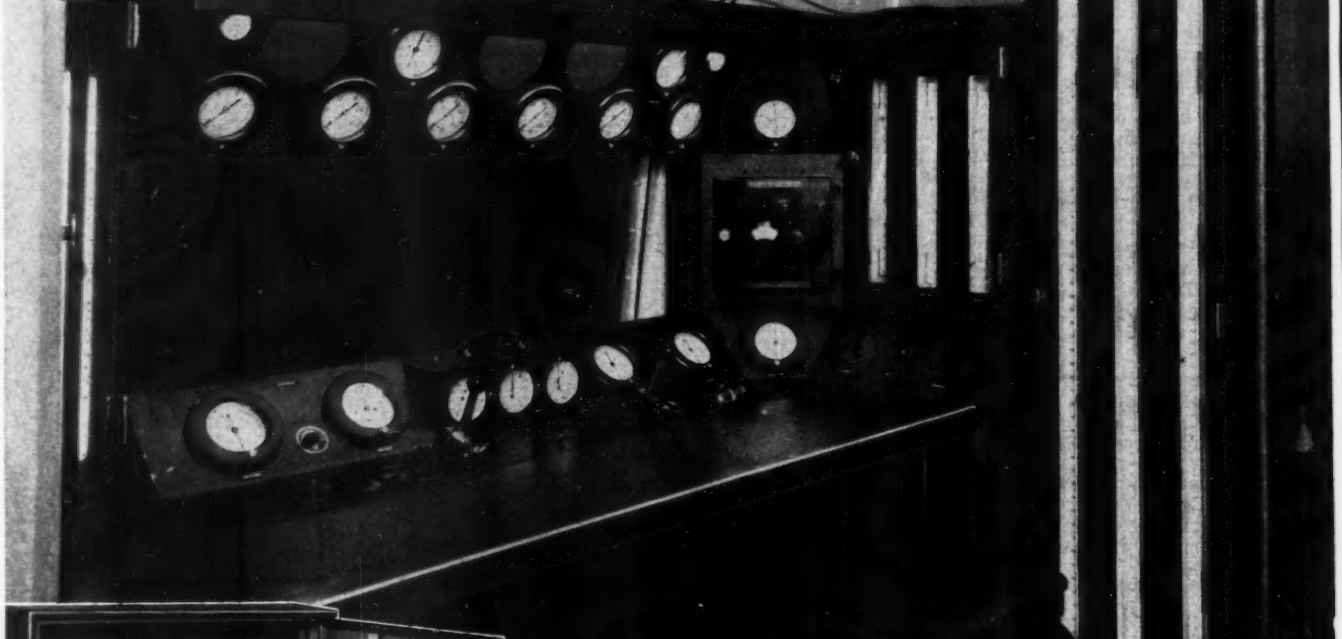
Write for Catalog and Engineering Data

AERO SCREW COMPANY

19th Ave. at 12th St., Rockford, Illinois

Modern CONTROL EQUIPMENT *Speeds* ENGINE TESTING

100% MERIAM EQUIPPED



★ This view, of cabinet with front door open, shows how manometers and fluorescent lights are arranged for good lighting and quick accessibility. Installation is for a prominent aircraft engine manufacturer.

THIS control equipment, for a production stand testing aircraft engines, is a highly efficient unit.

All manometers required are housed in cabinets with fluorescent lighting, providing utmost comfort and visibility in reading.

Meriam manometers measure manifold pressure, airflow, carburetor pressure drop, venturi pressure, air stack pressure, crank case pressure and other pressures, vacuums and differentials as required.

You, too, may have a measurement or test problem which Meriam instruments and engineering could solve.

THE MERIAM COMPANY

1953 West 112th Street ★ **Cleveland, Ohio**

MERIAM — THE INSTRUMENT PEOPLE

June Production Was Nearly 7,100 Planes; Arnold Estimates 115,000 More in Next Year

Washington (AVIATION Bureau)—The June figure on aircraft production is given as 7,094, a fraction above May's 7,087. May's original figure was 7,200, but this was later revised downward.

Again poundage is the figure to watch, not numbers. With continued emphasis on heavy bombers, June weight went up 5,000,000 lb. over May's airframe weight of 60,000,000. WPB put May dollar volume of planes and equipment 5 percent above April. On that basis, planes alone increased 9 percent.

However, Acting Secretary of War Patterson, said that deliveries were below schedule in number and that "in the next six months we must produce 61 percent of the total number of airplanes scheduled for 1943."

Navy announces that 9,000 planes were added to its air arm in the first half of 1943. This does not represent a net increase since some were trainers and utility craft. Also the Navy lost some planes by transfer to the Army and by lend-lease to other powers. However, for each dozen combat planes in the Naval forces in Dec. 1942, there are now more than 20. Seventy percent of the Navy planes produced in June were combat types.

WPB said there were difficulties in production of fighter planes for the Army, but that the bomber program was almost on schedule. In numbers, bomber acceptances were ahead of schedule. Single-engine bombers made a poor showing in April but the number picked up 49 percent in May. Navy fighters increased 18 percent in number.

In a statement before the House Appropriations Committee, which was considering the Army's 1944 $71,500,000,000 fund since passed, Gen. H. H. Arnold, chief of the Army Air Forces, said that of 99,740 planes provided for in this particular appropriation, 36,000 would be bombers, 38,000 fighters, 12,000 transports, and 9,000 trainers. The remaining 10 percent would be miscellaneous. This breakdown shows a projected number of bombers almost equal to fighters. It also reveals a tremendous fleet of transports in prospect, as compared with the several hundred now in operation. This backlog will have commercial value after the war and will have to be disposed of by some liquidating agency.

In a statement before the House Civil Service Committee in the interest of enlisting more workers for the aircraft industry, Gen. Arnold estimated that 115,000 airplanes will be built "in the next 12 months," that is by the early summer of 1944. The General said that many more bombers are flying to England and that 12,000 more civilian workers are needed to service the planes there.

Meanwhile, Charles E. Wilson, vice chairman of WPB and chairman of its Aircraft Production Board, is discussing incentive pay plans with manufacturers. He says that if output could be increased 10 percent by this means, the need for 100,000 additional workers would be overcome.

Wilson recently appointed Arthur H. Bunker, director of WPB's aluminum and magnesium division, to head an aircraft aluminum products control committee. Its job is to step up production and distribution of aluminum forms, lack of which was causing serious delays at some points in the industry (p.294 July AVIATION).

CG-4A Glider Output Increasing in West

Production of CG-4A gliders in the Midwest and on the Pacific Coast continues to go up. The War Department has let a $15,000,000 contract to the Gibson Refrigerator Co. of Greenville, Mich., which delivered its first glider to the Army in Oct. 1942, six months after stopping refrigerator production. This contract is announced to be larger than one signed by the company last year.

In the Los Angeles area, Timm Aircraft Corp. and eleven "associate producers" estimate that their deliveries of CG-4A's will increase 10 to 15 percent a month. The associates concentrate on making assemblies, while Timm obtains materials and supervises manufacture.

Manufacturing Committee Organized by Coast AWPC

Los Angeles (Special to AVIATION)—Creation of a manufacturing committee—a policy body to coordinate activities concerned with various phases of manufacturing and production—is announced by the West Coast Aircraft War Production Council, with F. W. Conant, Douglas vice-president in charge of manufacturing, as chairman.

Vice-chairman is H. E. Ryker, Vega's executive vice-president in charge of manufacturing. He will also be responsible for operation of the materiel section of the committee, which will concern itself with the maintenance of a steady flow of materials to producers.

At its first meeting, the new committee created a specialists panel on field service and spare parts, operating through a project group composed of Otto P. Graff, Vega; Harvey Tafe, Consolidated Vultee; and Frank Lyons, North American. This group will coordinate the flow of important information on the operation of warplanes on the battlefronts and assure delivery of spare parts.

Disposition of Government's Aircraft Plants Is Too Much for Washington to Think About

Washington (AVIATION Bureau)—What to do with government-owned aircraft plants after the war (also see p.286 July AVIATION) is too big a problem to engage the present attention of men who are capable of handling it. It will become part of an over-all reconstruction program for this country and probably for the world at large.

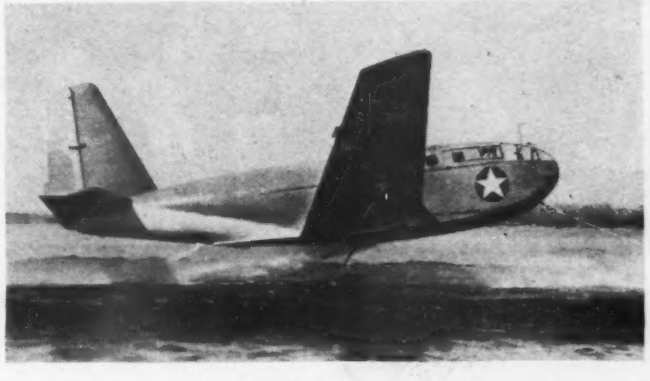
Figures released by the OWI show that total investment in aircraft plant—June, 1940, through Mar. 31, 1943—is $3,326,628,000. Of this amount, $3,084,782,000 is public money, mostly from the Defense Plant Corp.; only $241,846,000 has been invested by the industry. The aircraft plant total includes airframes, engines, parts, and accessories. To it must be added, of course, the value of all aircraft facilities built prior to 1940, which by comparison is a small sum.

Aircraft plant expansion is the largest of all war industries. Only three others exceed $2,000,000,000: Ship construction, guns and other ordnance, and explosives (including shell loading and bombs).

In the three-year defense and war period, all war plants built, building, and arranged for are valued at about $20,000,000,000, including a small amount for conversions. Before the war this country had about $50,000,000,000 worth of industrial plant. So the postwar total will approximate $75,000,000,000. Of that amount, the government will own $15,000,000,000 worth or, as *Business Week* points out, about one-fifth of U. S. industrial facilities. And roughly one-fifth of that fifth, just over $3,000,000,000 of public money, will be in aircraft plant.

What will be done with it? Of course, all the producers are studying non-aircraft durable goods manufacture. Some believe there will be a substantial postwar plane market. Others coldly figure the requirement at 2 to 8 percent of the present output.

DPC's plants are nearly all well built; none is strictly temporary in design. However, few of them are laid out for other than their original



INVADERS' "AMPHIB" GLIDER

Designed for Marine and Navy war theater work, this amphibious glider is built of molded plywood and other non-strategic materials by Allied Aviation Corp., Baltimore and Winston-Salem, N. C.

purposes. And worst of all there is the "all or nothing clause" — the manufacturer must take up the option on all of the facilities he is renting or none.

Option prices are high, but chances are that they will be thrown open to negotiation.

Five of the largest aircraft plants are owned outright by the Army and operated under management contracts in which there are no option clauses. It is understood that the Army is in the process of transferring three more plants from a rental to a management contract basis. Disposition, therefore, is up to the military.

There are no purchase options on aluminum, magnesium, and synthetic rubber facilities. Government ownership in them is so large —by comparison with prewar capacities—that the question of who should have the options was left for later solution.

PMI Lists Objectives

Close cooperation with government departments for increasing war output and research to develop new postwar uses for metal stampings have been announced as objective of the Pressed Metal Institute by its president, George E. Whitlock.

"Only by united effort, exchange of data, and pooling of experience can maximum results be obtained," said Mr. Whitlock's statement.

The Institute, formed recently by some sixty representatives of sheet and strip metal fabricators, rolling mills, and press manufacturers, has already established offices in Washington and New York.

Nash-Kelvinator Corp. To Build Helicopters

Production of Sikorsky helicopters, is being undertaken on a quantity basis for the AAF in Detroit by Nash-Kelvinator Corp. under license from United Aircraft Corp., Eastern producer of the R-class craft.

"The helicopter we will build," said Nash-Kelvinator President G. W. Mason, "represents an advance over the model which recently underwent tests at Wright Field. Production will start just as quickly as our facilities can be made ready and men are trained sufficiently to do the required work."

Manufacturers Report Increased Production Rates; Two Companies Make Administrative Changes

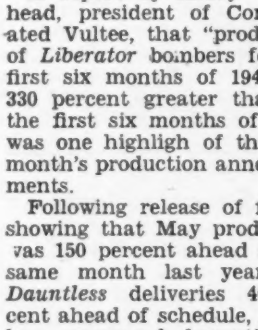
A report by Harry Woodhead, president of Consolidated Vultee, that "production of *Liberator* bombers for the first six months of 1943 was 330 percent greater than for the first six months of 1942" was one highligh of the past month's production announcements.

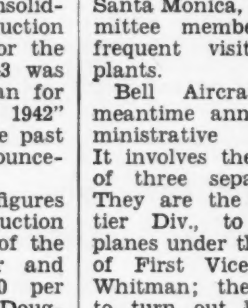
Following release of figures showing that May production was 150 percent ahead of the same month last year and *Dauntless* deliveries 40 per cent ahead of schedule, Douglas announced formation of "a management committee to provide a more compact and streamlined administration of the company's plants and operations." With headquarters at the parent plant in Santa Monica, Calif., the committee members will make frequent visits to various plants.

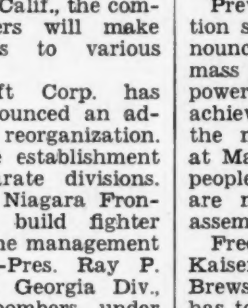
Bell Aircraft Corp. has meantime announced an administrative reorganization. It involves the establishment of three separate divisions. They are the Niagara Frontier Div., to build fighter planes under the management of First Vice-Pres. Ray P. Whitman; the Georgia Div., to turn out bombers, under Vice-Pres. Omer L. Woodson; and the Ordnance Div., under Carl F. Lozon. Charles L. Beard, secretary and treasurer, will coordinate activities of all plants as administrative assistant to Pres. L. D. Bell.

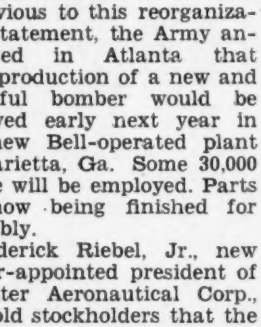
Previous to this reorganization statement, the Army announced in Atlanta that mass production of a new and powerful bomber would be achieved early next year in the new Bell-operated plant at Marietta, Ga. Some 30,000 people will be employed. Parts are now being finished for assembly.

Frederick Riebel, Jr., new Kaiser-appointed president of Brewster Aeronautical Corp., has told stockholders that the company's output, with the exception one model, is exceeding expectations. To employees he said that Navy dive bomber records were being broken.









Appointed to new positions by Bell Aircraft are (top panel, left to right): Carl. F. Lozon, Ray P. Whitman, Charles L. Beard, and Omer L. Woodson. Members of new Douglas management committee (bottom, left to right) are Frederic W. Conant, vice-pres., manufacturing; Ralph V. Hunt, vice-pres., comptroller; John M. Rogers, vice-pres., contract administration; Pres. Donald W. Douglas; Arthur E. Raymond, vice-pres., engineering; and A. M. Rochlen, director industrial and public relations.

Contract Renegotiation Not Likely to Be Modified

Washington (AVIATION Bureau)—As a result of renewed opposition by aircraft and other industries to the contract renegotiation law, the House Naval Affairs Committee has held a series of hearings with a view to modifying the act, repealing it, or letting it stand. Hopes for modification, however, are not optimistic.

Substantially the original objections of industry to the bill were reiterated by the witnesses, who included Francis A. Callery, vice-president of Consolidated Vultee, and Ernest R. Breech, president of Bendix.

Harry Woodhead, president of Consolidated Vultee, meanwhile reported that "earnings of the Fort Worth Div. for 1942 amounted to only between $30,000 and $40,000 after taxes."

The government contends that the duty of price adjustment boards under the law is to prevent undue profit from war, and that the matter of taxes and accumulation of reserve funds is up to Congress and other agencies. Therefore, Army, Navy, and other price adjustment boards do not distinguish between the auto industry, for example, which has a hungry postwar market waiting for it, the aircraft industry, which can sell only a fraction of its present capacity output, and the machine tool industry, which is still worse off, having glutted the country with enough tools to last for years.

The renegotiation law will remain substantially intact through the war, largely because the public views profit taking as a repetition of the millionaire-making that took place in the last war. In fact, the law was extended to cover RFC, lend-lease, and the Department of Agriculture while the hearings were in progress.

Production-Battle Citations

★ One Star ★

H. M. HARPER Co.

Army-Navy "E"

ACE MFG. CORP.
AGAWAM AIRCRAFT PARTS, INC.
AUTOMOTIVE MAINTENANCE MACHINERY Co.
BERRY BROS.
BLAW-KNOX Co. (Blawknox, Pa.)
BORG-WARNER CORP. (Rockford Ill., and Norge Div., Muskegon Heights, Mich.)
THE BRISTOL Co.
BROWN INSTRUMENT Co.
CARBORUNDRUM Co.
CHAMBERSBURG ENGINEERING Co.
DETROIT GASKET & MFG. Co.
DOW CHEMICAL Co. (Pittsburgh, Calif.)
GENERAL ELECTRIC Co. (York, Pa., Pittsfield, Mass.)
GENERAL INSTRUMENT Co. (Elizabeth, N. J.)
GRAHAM-PAIGE MOTORS
HEINTZ & KAUFMAN, LTD. (South San Francisco)
HEYWOOD WAKEFIELD Co.
JACOBS MFG. Co.
JOHNS-MANVILLE PRODUCTS Co. (Lompoc, Calif.)
I. F. LAUCKS (Seattle Plant No. 1)
LIBRASCOPE, INC.
LINK-BELT Co.
LISLE CORP.
LOMBARD GOVERNOR CORP.
D. W. ONAN & SONS
PACIFIC GEAR & TOOL WORKS
RESINOUS PRODUCTS & CHEMICAL Co.
TAYLOR INSTRUMENT COMPANIES
WORCESTER PRESSED STEEL Co.
WORTHINGTON MOWER Co.
L. A. YOUNG SPRING & WIRE Co.

★ FOR THE RECORD ★

Hamilton Standard Propellers Div. of United Aircraft has reorganized its engineering staff to handle the introduction of new developments and models in limited and general production.

Kellett Autogiro Corp. has resumed its former name, Kellett Aircraft Corp.

Royal Dutch Airlines has leased offices at 521 Fifth Ave., New York.

Bendix Aviation Corp.'s new Illinois Div. factory in the Chicago area, huge injection carburetor plant, is in initial production with tooling about half complete. Women form 75 percent of the workers.

Largest order ever placed for Goodyear's Pliofilm wrapping material has been received by the company from AAF.

Borg-Warner Corp. has purchased McCulloch Engineering Co., Milwaukee, manufacturer of superchargers.

Rohr Aircraft Corp. has leased the San Diego Country Club as a recreation center for its employees.

An aircraft section has been formed in the industrial dept of Johns-Manville. William S. Hough is manager.

Fairchild Aircraft Div. has converted a large portion of its Hagerstown, Md., plant into a test laboratory. It is under the direction of M. J Frank.

Benchmaster Mfg. Co. is new name of Duro Mfg. Co., Los Angeles.

An aviation dept. has been opened in New York by American Flange & Mfg. Co.

Fritz Ziebarth construction company has taken over operation of Morrow Aircraft Corp., Rialto, Calif.

Ryan Aeronautical Co. has added several additional factory buildings to its plant at San Diego.

Curtiss C-46 *Commandos*, now produced in the East, are also to be built in quantity in a factory in Missouri.

Assembly Lines

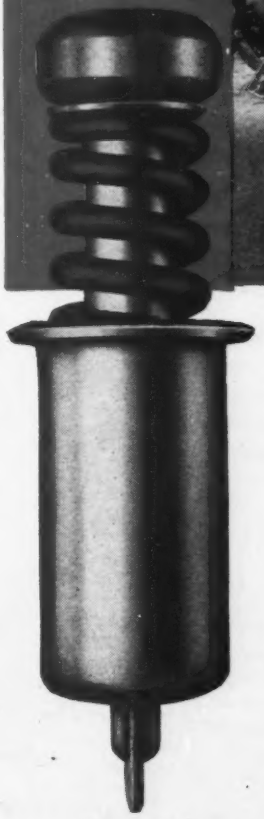
Enough paper to cover a 35-ft. highway for 100 mi. is used in a year for the 273,000 blueprints filed on *Liberators* and *Liberator Expresses* at Consolidated Vultee's Forth Worth plant. The printing machines take from 36 to 75 sq. ft. a minute.

Plywood — 6,000,000,000 board feet of it—is estimated to have saved 2,500,000 tons of aluminum, steel, and copper and 200,000 tons of rubber in plane production last year. Timbermen, it is reported, are exhausting the accessible supply of veneers and hardwoods and are searching for substitutes.

Plastic distributor heads for planes are now being made by Ford on 500-ton presses which used to form plastic automobile parts.

From England comes word of a new method for detecting surface flaws in non-ferrous metals by fluorescence. Materials are heated in a liquid, then suspended in its vapor. Fluorescent crystals which form along the line of a crack or fissure become green when exposed to ultra-violet light, thus exposing the flaws.

Development of a process which saves high percentages of critical materials in the rolling of propeller blade steel, as well as considerable machining time, is reported by the American Rolling Mill Co.



You test it . . .
they did . . .
and found it worth-while

THE LOXIT SKIN FASTENER . . . was recently tested by laboratory technicians at Consolidated Vultee Aircraft Corporation, builders of the famous Liberator B-24 Bomber. Results substantiated every claim made.

SAFER . . . special design and rugged construction adds increased safety factor. Appeals to women workers.

FASTER . . . simply line up skin holes . . . compress . . . snap and it's in.

EASIER TO USE . . . LOXIT Skin Fasteners need to be held in compression only at instant of application. Motion studies show this saves 75% of worker fatigue and speeds operation an average of 10%.

LONG-WEARING . . . hardened steel body shell and heat-treated plunger reinforced by tubular sleeve increases life span.

SMALLER . . . easier to handle in close quarters, particularly near right angle bends.

FREE SAMPLES

A request on your business letterhead will bring you LOXIT Skin Fasteners for your testing. You'll find it fits any standard type pliers or gun. Write today. Scovill Manufacturing Company, 20 Mill Street, Waterbury, Connecticut

LOXIT SKIN FASTENERS SPEED THE JOB
A SCOVILL PRODUCT

this Check list of war uses

CAN HELP YOU SAVE TIME-MONEY-METAL WITH

MEYERCORD DECALS

DECALS ARE USED ON:

Airplanes
Tanks
Armored cars
Combat vessels
Cargo ships
Blimps
Gliders
Motorized equipment
Ordnance
Radar
Combat radio communications
Marine — Aircraft
Armor — Portable
Electrical equipment
Navigation devices
Fire control
Bomb racks
First aid kits
Fuel cells (rubber)
Life rafts (rubber)
Helmets
Antennae
Fuel and oil containers
Air filters
Airplane propellers
Fire fighting equipment
Water pumps
Tools
Flares, bombs and shells

DECALS ARE USED FOR:

Insignia (Airplane)
Operation and maintenance instructions
Stowage and packing diagrams
Interior Markings (shipboard)
Instrument panels (also fluorescent)
Nameplates
Wiring diagrams
Fluid line identification charts
Airplane tail numerals
Anti-sabotage inspection seals
Invasion identification (flags)
Windshield passes to vital areas
Spare parts listings
Stowage box identification
Phosphorescent markings (interior)
Organizational devices and insignia
ODT compliance identification
Octane designations
Nomenclature designations
Capacity or load limit
First aid instructions
Assembly coordination numbers
Civilian Defense insignia
Dial faces
Inventory numbers

Identification and instruction data requirements for war equipment are enormous. Uniformity, durability, lasting visibility and speed of application are imperative. In war—*or peace*—Meyercord Decals meet imperative demands . . . on any surface. They're durable, washable, highly visible, permit use of any color and replace strategic metal. No sharp edges, screws, rivets or bolts. This partial list of war-time decal uses may suggest their adaptability to your own product. Competent designing and technical research service available . . . free. Address Dept. 1138.

Speed Victory ▫ ▫ Buy War Bonds!

50th Anniversary 1943

DECALS SAVE METAL

THE MEYERCORD CO., CHICAGO

World's largest manufacturer of Decalcomania

5323 WEST LAKE STREET • OFFICES IN PRINCIPAL CITIES

Surface Carriers Commence Campaign For Future Commercial Airways Rights

Washington (AVIATION Bureau) — Surface transportation's drive to get into the air is in full swing. Financial and political power is being organized everywhere to that end. The Lea-Bailey bill, HR-1012, a rewriting the Civil Aeronautics Act (also see p. 289 July AVIATION) and the President's interdepartmental aviation committee, which is formulating foreign policy, are both being hindered by participants in the conflict. At no time in the past has there been so much uncertainty as to the future of both manufacture and operation of aircraft.

Except for the fact that most parties interested are engaged in aiding the war effort, there would be a pitched battle in progress now. Three main groups are seeking rights in the air: The bus lines have made a dozen applications, the Maritime Commission has launched an investigation to determine the postwar needs of shiplines for auxiliary air services, and the railroads are working quietly but powerfully behind the scenes.

Under the Civil Aeronautics Act, the Board is empowered to reject surface carrier applications which it thinks might create a monoply or work against the public interest. CAB has frowned on surface-air combinations and is in sympathy with the Department of Justice, which wants to intervene in several applications now pending. Tom C. Clark, assistant attorney general in charge of the anti-trust division, has asked leave to appear at hearings on proposals of Shawmut Air Freight and Transport, Greyhound Corp., Burlington Transportation Co., Rebel Air Freight Co., Southwestern Freight Lines, and Universal Air Freight Corp.

Some motor carriers, headed by Greyhound Corp. and Keeshin Freight Lines, intend using helicopters and planes. Probably most companies are merely trying to stake out claims for the future, for they must know that the cost of flying ordinary cargo still eats up the value of the extra speed on a short run. And the precise availability of commercial helicopters is still beyond reasonable prediction.

The Maritime Commission has set up a Postwar Planning Committee with Adm. Howard Vickery, Commission vice-chairman, as director. Under it is an aviation subcommittee, headed by R. Earle Anderson, director of the Commission's finance division. The intention is to propose legislation which will enable shiplines to set up auxiliary air services or their own airlines.

One steamship line, Matson Navigation Co., has filed an application for air routes in the Pacific and acquired facilities at the San Francisco airport. The application proposes that the company sell tickets good for a certain destination; the passengers would go by air or boat as they chose. By that means, competition between surface and air services of the company would be avoided and presumably Section 408 of the Civil Aeronautics Act (governing mergers) would not apply.

The railroads, for one thing, are obstructing report of HR-1012, which, though rewritten several times, still prohibits control of airlines by ground services. They would not like to see a minority report published and hope that in time they can get Section 408 eliminated. A second application for helicopter freight service has been filed by Burlington Transportation Co., subsidiary of C. B. & Q. RR. Total routes contemplated cover nearly 10,000 mi. in 25 states.

But none of the surface transportation people are taking the law too seriously. They argue that all persons should have a right in the air, and they have the idea that this concept will ultimately win out.

CAB Renders Decisions Affecting Ten Carriers

Washington (AVIATION Bureau)—Addition of United Air Lines and Transcontinental & Western Air to the carriers serving this city brings to five the number of lines authorized by CAB to make scheduled stops at Gravelly Point. Although already served by American, Eastern, and Penn-Central, Washington has long been a bottleneck.

United will fly from Toledo and TWA from Dayton making intermediate stops at Columbus and Wheeling.

CAB has also amended the certificate of Delta extending its route from Shreveport to New Orleans, via Alexandria and Baton Rouge, and New Orleans to Fort Worth-Dallas. Delta now operates between Fort Worth and Charleston. Eastern was granted permission to serve Lake Charles as an intermediate point between Baton Rouge and Beaumont on its route originating in New York. The applications of National, Braniff, and Chicago and Southern for service between Forth Worth-Dallas and New Orleans via Baton Rouge, Alexandria and Shreveport were denied. Mid-Continent Air Lines and Kansas City Southern Air Transport filed applications shortly before the hearing of this case for routes from Tulsa and Kansas City to New Orleans, but the Board denied the motion, allowing them to appear as intervenors.

Authorization to include Palm Springs, El Centro and San Bernardino, Calif., on its route to Canada has been granted Western Air Lines. The new stops will provide the three cities' first link with the nation's air network. Inauguration of the new stops will depend upon travel requirements of the military services.

Acme Photo

TRANSATLANTIC GLIDER . . . AS LOAD WENT ABOARD

A cargo of vaccines for Russia and radio and engine parts is stowed through the nose of the CG-4A glider that recently made the first trip across the Atlantic towed by a Douglas C-47. Designed by Waco, the glider was built by a New York piano manufacturer. It covered the 3,500 mi. from Montreal to England in 28-hr. in an unannounced number of stages. None of these jumps was believed to have been longer than one 1,177-mi. test flight made during the six months of preparations for the trip. The crew was supplied by the RAF Transport Command, and the glider, which has an 84-ft. span and capacity of 1½ tons, carried a pilot and co-pilot.

Fare Orders Dismissed

Washington (AVIATION Bureau)—CAB's show cause order calling for ten percent cuts in passenger rates has been dismissed as to five carriers which have made what the Board calls "a substantial reduction in their passenger tariffs." The order remained effective, however, against six other lines, Braniff, Chicago & Southern, Delta, National, Northwest, and Penn-Central.

With a dissenting opinion by Member Harllee Branch, the order was dismissed against American, Eastern, TWA, United, and Western.

★ CROSS COUNTRY ★

Cincinnati Chamber of Commerce has reorganized its aviation committee to promote the expansion of the city's airport facilities and commercial and civilian flying. . . . PAA has begun service to Mexico and Central America from its new establishment at Lockheed Air Terminal, Burbank, Calif. . . . United Air Lines proposal to acquire controlling interest in the Mexican airline, Lineas Aeras Mineras, S. A., has been approved in a report submitted by CAB Examiner J. Francis Reilly. . . . American Export Airlines announces that civil service has been resumed on the northern short summer route between New York, the United Kingdom, and Africa.

HANSEN HOSE CLAMPS

FIT ALL STANDARD HOSE SIZES!

Hansen Hose clamps can be used on a
standard sizes of hose and are acknow
edged as the outstanding hose clamps on
the market. Their exclusive features tell the
story of their remarkable performance and
nation wide popularity.

Unlike ordinary hose clamps they have two grips instead of one . . . one on outside of hose, other on inside of hose . . . a distinct two to one advantage.

Compression grip — no tearing or cutting of hose.

Simple and easy to install, requiring no special tools.

Economical — can be used many times over.

Extra long stem . . . protects and prolongs the life of the hose.

Safe working pressure of 500 pounds.

Neat, trim and tailored.

Send for free catalog on Hansen Industrial Air Line Equipment

THE HANSEN MFG. CO.
1786 EAST 27th STREET • CLEVELAND, OHIO

HANSEN
INDUSTRIAL AIR LINE EQUIPMENT

AIR HOSE COUPLINGS • HOSE CLAMP SOCKETS • HOSE CLAMPS
AIR BLOW GUNS • HOSE CLAMP PLUGS • ENGINE CLEANERS
SANDBLAST CLEANERS • AIR-LIQUID SPRAY GUNS

New System Speeds Warplane Overhaul

Airplanes are now grounded for much shorter periods due to topnotch servicing developed under a new maintenance and training plan being instituted at Canadian air stations.

The old plan was based on a rule of the thumb system whereby the number of available mechanics was divided into the number of aircraft to be overhauled. The new system is based on the principle that the mechanics should be concentrated on a few airplanes to get these back into service as soon as possible.

There are now three separate checks over the work done, first by the corporal in charge of the mechanics, then by a technical sergeant, and finally by a flight sergeant.

In the new system, silver, blue, and red stars rate the mechanic's ability, giving incentive competition which has bettered training records 25 percent. Silver is for exceptional performance; red for below-par. The shops have posted large "thermometer" indicators to apprise the maintenance crews of their progress in overhauling the planes.

★INTERNATIONAL BRIEFS★

While extent of the program is unknown, Swiss Travel Propaganda Bureau announces that Switzerland has definite plans for international air services after the war.

A new Swedish aircraft plant has been built at Jonkoping by the A. B. Flyindustri of Halmetad. The new plant at present will build gliders.

Mr. Churchill recently inspected Britain's latest secret aircraft of various types. At least one of the models is reported to be such a decided technical step over present models, that the success of the prototype is expected to change the trend of aviation development.

Fight "Shots" for Training

The RAF now employs films made during fighter sorties to train new gunners and to help others polish up their technique. The small camera used is fitted in one wing and synchronized with the guns.

Interest has been shown by the USAAF, which in forthcoming combat training is expected to make use of both the RAF films and pictures taken by American planes.

Canadian Notes

Increased volume of urgent wartime traffic has brought establishment by Trans-Canada Air Lines of a central passenger reservation control office in Toronto. The new "nerve center" has direct wires to Winnipeg, Halifax, and New York City, and it is estimated that the system handles daily more than 2,000 phone calls and 6,400 teletype messages on seven circuits. With a staff of 70, the office operates 24 hr. a day. Recent extension of TCA service to Victoria, B. C., gives the company a 3,900-mi. trans-continental route.

Meanwhile, TCA reports carriage of more than 5,500,000 lb. of mail since its inception in Sept., 1937. The load jumped from 1,089,814 lb. in '41 to 2,306,812 lb. in '42.

Employing a DC-2, Canadian Pacific Air Lines is supplying gasoline to an isolated development at Mont Joli, Northern Quebec, by dropping drums of the fuel into the camp lake, which is too small for efficient operations by planes with pontoons. Canoes are used to tow the floating drums ashore.

British-Combine Photo

"FIXER" ON WHEELS

Important unit in RAF combat-plane field maintenance is this mobile workshop, which includes small lathe, drills, battery charging board, and numerous tools. Here, air-craftsman reconditions fighter plane stabilizer, using shop's compressed air sprayer.

On Schedule . . . by "Vista"

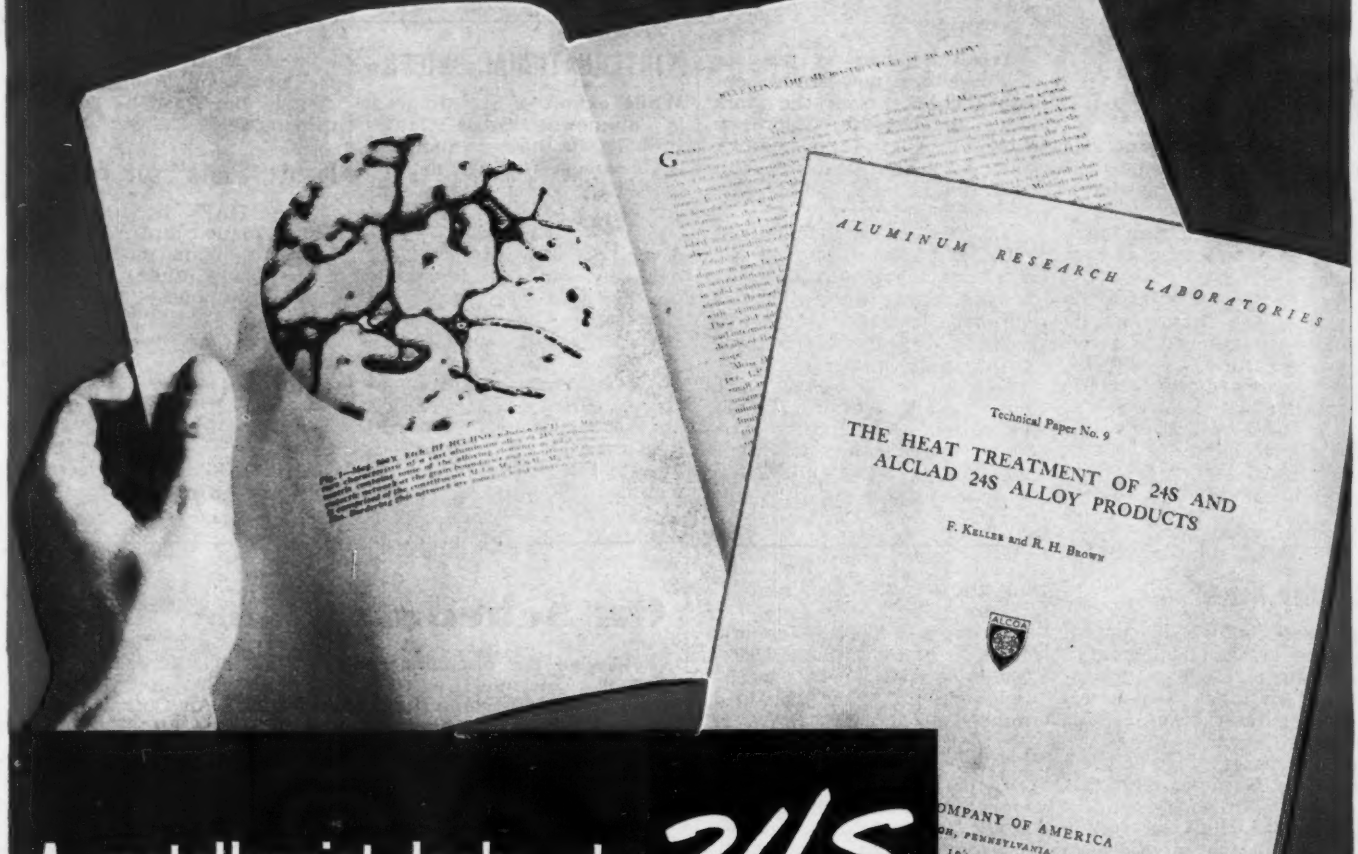
Following the appointment of Lord Knollys, former Governor of Bermuda, as chairman of the British Overseas Airways Corp., came the naming of RAF Air Commodore Critchley as its chief executive officer. Miss Pauline Gower, well known in British aviation circles and hitherto a commander in the Women's Air Transport Auxiliary, was appointed a director.

General impression created in Britain by these various Air Ministry appointments is that sound business management is being favored over air operation experience in BOAC's present condition. The members of the Board are now a banker, accountant, factory owner, union organizer, private pilot, and a woman with a commercial license. The British press, while welcoming the appointment of a board which can be expected to further British air transport, is anxiously awaiting the first indications that its policy will be realistic and that it will take the steps necessary to give British air transport its rightful place.

Another problem is the establishment of a working arrangement with the new RAF Transport Command, which threatens virtually to eliminate international air routes operated by the BOAC. As reported some time ago, almost the entire old Board resigned when the Air Ministry opened fire against private enterprise in BOAC, and the clamor which is still arising in Commons shows that the average Englishman still doesn't like the control exercised by the British Government, preferring to see air transport placed under an air transport ministry, or under an empire shipping and air transport board. Therefore, as matters stand now, the British airline horizon is by no means settled, and some changes are generally expected before the set-up takes a form promising an even tenor of concrete results.

Somewhat belatedly, the report on the operations of Tasman Empire Airways has reached us. Flying between Sydney and Auckland with a regularity of 97½ percent in the period extending between inauguration of services in Apr. 1940 and the end of 1942, the line has carried 439,000 lb. of mail and freight, together with some 5,040 passengers. Considering the notorious weather conditions of this 1,340-mi. stretch of water separating Australia and New Zealand, the results are praiseworthy.

A new airline in Iran, known as Persian State Airlines, flies a weekly service between Teheran and Bagdad. Before the war, this route formed a regular part of the German Lufthansa's Berlin-Teheran service. Apparently a need has arisen for continuing an air connection between these two important Middle Eastern cities. Total flying time is about 4 hr., employing planes said to be reasonably modern.



A metallurgist looks at 24S

Aluminum alloy 24S is used in aircraft construction for parts subjected to high stress; 24S and Alclad 24S sheet and strip for airplane skin and structural members, 24S wire for rivets. Parts made of this alloy are hardened and strengthened by heat treatment.

Technical Papers No. 8 and No. 9, pictured above, tell how you can check the effectiveness of heat treatment. Metallographic methods of examination and the results obtained are outlined. You can detect variations from standard practices by comparing samples taken from your production with those pictured in these papers.

Practices described have been used at Aluminum Research Laboratories and in the industry for many years. When these methods are followed closely, and the proper skill attained, it is possible to determine many pertinent facts about 24S from metallographic examinations. Your metallurgist should have these two booklets.

For copies of Technical Papers No. 8 and No. 9, write ALUMINUM COMPANY OF AMERICA, 2182 Gulf Bldg., Pittsburgh, Pa.

ALCOA ALUMINUM

Aviation Finance

Pan American Airways Corp in its world-wide operations last year did a total business volume in excess of $109,000,000, while its net earnings thereon amounted to $3,780,015 or $1.95 a share, compared with $3,361,251 or $1.73 a share in 1941. Business under contract with the government for construction, military transport, and related services came to $59,582,567, while the volume on regular operations was $49,926,946, comparing with $10,035,153 in 1941.

Bell Aircraft Corp. deliveries of both aircraft and ordnance equipment will be substantially larger in 1943 than in 1942, and it is anticipated that a reasonable profit will be realized this year, Pres. Lawrence D. Bell informed stockholders recently. No decisions, he added, had been reached with the renegotiation board on the company's 1942 profits.

Transcontinental & Western Air reports net profits of $313,327 for the March quarter, compared with a loss of $310,651 in the like 1942 period. Commenting on the favorable results, Pres. Jack Frye said that "the present need for high speed transportation between industrial centers on our routes is only partially served by the limited airliners now available."

Aviation Corp. reports net earnings of $1,902,163, or 33c. a share, for the six months ended May 31, compared with $2,478,291 or 43c. a share in the like 1942 period. Profits last year included $1,318,308 extraordinary earnings on the sale of securities. Net sales this year totaled $37,780,791, against $17,423,296 in the similar 1942 six months.

By RAYMOND L. HOADLEY

Welcome News on Taxes . . . Postwar Reserves Enigma . . . Net Earnings Low Despite Sales Zoom

DECISION by Congressional tax leaders to let 1943 corporate tax rates stand as they are proved good news last month to the aviation industry. Aircraft manufacturing and air transport companies alike have been setting up 1943 normal corporate tax reserves as high as 50 percent in the belief that when Congress got around to final action on a new tax bill late in the year the 40 percent current rate would be boosted retroactively by 5 or 10 percent.

Now they have the assurance, in common with all industry, that the present status quo will prevail in tax rates—at least until next year.

In the meantime, aircraft manufacturers are keeping the all-important matter of adequate reserves for postwar transition to peacetime operations very much before Congress and the people. Last month Glenn L. Martin, speaking at Omaha, pleaded for tax-free reconversion reserves, warning of industrial collapse unless something is done to prevent these reserves going to the government in taxes. Lucien W. Shaw of Lockheed Aircraft Corp. presented the U. S. Chamber of Commerce with a study showing that renegotiation cannot work in a manner producing fairness and equity and still avoid enormous wastes of time.

More recently, Francis Callery of Consolidated Vultee called on Congress to leave the industry with sufficient reserves to survive the postwar transition period with enough "seed money" to develop peacetime commercial aviation.

Aircraft companies, Callery pointed out, are making less profit on warplanes which they created themselves than are other companies which are filling in on war work and which promise to enjoy large demands for their own products after the war. These old line manufacturers, it might be added, with a good background of earnings and larger capital reserves, can make up to three times the profit of the aircraft manufacturers due to variance of the tax base under which the plane makers and the automotive industry (for example) operate.

First quarter earnings reports of three large aircraft companies indicate that net earnings, despite the huge gains in sales, are holding at comparatively low levels. These concerns had combined net profits of $5,452,060 in the March quarter, compared with $7,989,535 in the last three months of 1942 and $4,699,282 in the first quarter of 1942. Thus it seems that aircraft sales this year—in the neighborhood of $20,000,000,000 compared with $6,400,000,000 in 1942—probably will not result in any very substantial increase in earnings.

Pennsylvania-Central Airlines has made application to list its 481,790 shares, 331,790 of which are outstanding, on the New York Stock Exchange. The application disclosed that Penn-Central now owns eleven DC-3 transport planes, six of which are used in commercial airline operations. The others are assigned to cargo service under contract with the War Department.

All American Aviation, Wilmington, Del., is offering its stockholders 26,218 shares of preferred stock at $25 a share on the basis of one preferred for each ten shares of common. The unsubscribed stock will then be offered to the public at $25 a share.

Brewster Aeronautical Corp.'s production recently has been far in excess of expectation, except for one plane model, Pres. Frederick Riebel, Jr., told stockholders at the annual meeting. He said further that the management would endeavor to get the company's fiscal affairs in shape so that when the war is over it "will not fall flatter than a pancake." Brewster reports a loss of $1,436,369 for 1942 after provision of $700,000 for possible losses on government contracts. This compared with a profit of $12,808 in 1941.

Aircraft Accessories Corp. of Kansas City has called all its outstanding cumulative convertible preferred stock for retirement on July 30. Holders will be paid $9.90 a share plus all accrued and unpaid dividends, according to Pres. R. C. Walker.

Boeing Aircraft of Canada has received a $100,000,000 contract from the U. S. Navy for Consolidated *Catalina* flying boats. Jay Morrison of American Boeing has been appointed vice-president and general manager of the Canadian concern.

On the Raw Materials Front

More Aluminum Needed. With the 1944 aircraft program calling for increased output of heavy bombers, the government is forced to consider a further expansion in aluminum producing facilities. The white metal program now coming up will be the third undertaken by the government alone and the fourth when the 1940 Aluminum Co. of America program is included.

A survey has just been completed to find sites for the new project, and New York City is understood to have first call on any new facilities because of the availability there of both electric power and labor to supply an aluminum reduction plant of four to five pot lines. Such a plant would employ upward of 1,000 men and be capable of producing about 175,000,000 lb. of aluminum annually.

Other possible places for additional reduction plants, according to the survey results, are the Tennessee Valley Authority development area, where four to six pot lines could be handled; Philadelphia, three pot lines; the Bonneville Dam area in the Northwest with sufficient power to handle six lines; and Southern California, three to four additional lines.

Trouble with the Bonneville and California sites, according to war production officials, is that there is little labor available in those areas. In fact, the employment turnover is reported to have become such a problem in the Los Angeles area that serious consideration has been given to a proposal entailing transfer to New York City of at least a part of the aluminum plant in California.

Wages in aluminum plants are said to be below those paid in aircraft as well as many other war industries. For this reason it is difficult to hold workers.

Steel Drive. Since the estimated third-quarter steel supplies are 26 percent below the steel requests of government war agencies for that period, the War Production Board has been forced to initiate a special steel production drive. Object is to secure an extra 2,000,000 tons of steel, in the last half of 1943, for munitions, planes, and ships.

Thus the government plant expediters are turning their attention at long last to the lagging steel facilities expansion program. It seems to take an emergency of considerable proportions, such as the synthetic rubber and octane gasoline situations, to put through needed priorities.

Programs for new steel plants have been running six months or more behind schedules due to the lack of high priorities for important parts. Now that the heat is on, however, another important part of the war production effort will get the attention it merits.

Aviation People

JOHN GROVES, manager of the Washington National Airport, has been presented with a trophy by Pennsylvania Central Airlines for "outstanding and efficient administration of one of the world's most important air terminals."

LESLIE L. ASPELIN has been appointed director of engineering for Romec Pump Co. He has been with the U. S. Army Air Forces since 1936 and for the past several years has been chief of the Fuel Systems Unit, Power Plant Laboratory.

J. W. HENNEN has been named new Nashville Div. manager of Consolidated Vultee, succeeding Robert McCulloch, who returns to the West Coast. Before joining Consolidated in 1939, he was production chief for Boeing Aircraft.

MRS. JANET SEBASTIAN has been appointed first woman supervisor at the Nashville plant of Consolidated Vultee. In charge of the suggestion and cost improvement plans, she is one of the few women heading such an activity.

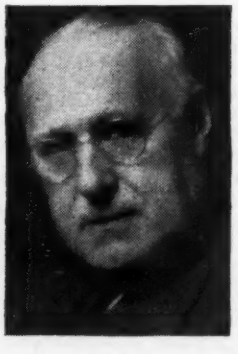
GEORGE NEWBOLD, asst. to the publisher of Aviation, retires after long service to the industry. He has been with the magazine since its inception in '16. Industry friends presented him with a farewell gift at a dinner given in his honor.

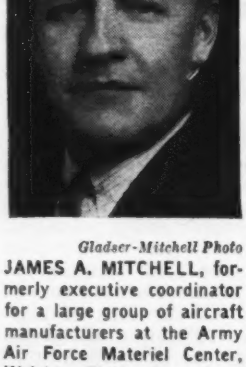
PALMER NICHOLLS has been elected president of Bendix Aviation, Ltd. In 1927 he organized the Pacific Airmotive Co., then sold this business to Bendix a few years later, remaining as general manager, which position he will retain.

Panagra Photo

CAPT. JOHN H. MILLER, veteran Panagra pilot, recently completed his 20,000th hr. of flying with the airline. He joined Panagra in 1931 and has been flying on the South American lines regularly since.

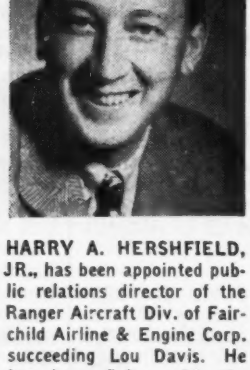
BENNETT H. HORCHLER, manager of the Aeronautical Engineering Review for the past three years, has been named executive vice-president of the Institute of the Aeronautical Sciences. He succeeds **MAJ. LESTER D. GARDNER** (center), who though resigning this post has been persuaded to continue advising the Council and accordingly has been elected Council Chairman. **GEORGE R. FORMAN** (right), who has been assistant treasurer, has been named assistant to Dr. Hugh L. Dryden, Institute president. Meanwhile, Russell F. (Scoop) Rogers, who for several years was an advertising representative of **AVIATION**, has been appointed manager of the Aeronautical Engineering Review. He has been with the Review for the past nine months.



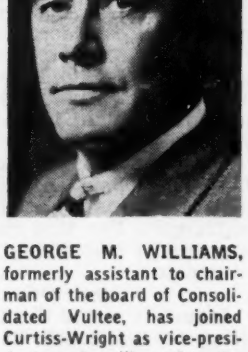


Gladser-Mitchell Photo

JAMES A. MITCHELL, formerly executive coordinator for a large group of aircraft manufacturers at the Army Air Force Materiel Center, Wright Field, has been elected v. p. and g. m. of Timm Aircraft Corp.

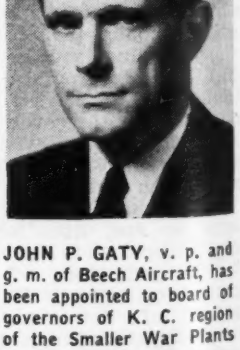


HARRY A. HERSHFIELD, JR., has been appointed public relations director of the Ranger Aircraft Div. of Fairchild Airline & Engine Corp. succeeding Lou Davis. He has been flying with the CAP on anti-submarine patrol along the East coast.



GEORGE M. WILLIAMS, formerly assistant to chairman of the board of Consolidated Vultee, has joined Curtiss-Wright as vice-president and will assist the president in an executive capacity. He is also president of Russell Mfg. Co.

FRANK E. CALDWELL, formerly of Northwest Airlines, has been named service manager, coincident with expansion of the service department of Pump Engineering Co. His duties will include special field assignments.



JOHN P. GATY, v. p. and g. m. of Beech Aircraft, has been appointed to board of governors of K. C. region of the Smaller War Plants Corp., according to an announcement made by Brig. Gen. Robert W. Johnson, chairman of the SWPC.

Recent Books

THE STRUGGLE FOR AIRWAYS IN LATIN AMERICA, by William A. M. Burden. Council on Foreign Relations, New York. 245 pages, statistical appendix, bibliography, index, illustrations, $5.

Like the airlines he describes, Mr. Burden, special aviation assistant to the Secretary of Commerce, has done a pioneer job of historical research and economic analysis that should attract the attention of every air transport executive who has let his imagination wander below the border.

Mr. Burden has obtained most of his information first-hand from airline and government officials and expanded it into an analytical scrutiny on the basis of a study made two and a half years ago for the Coordinator of Inter-American Affairs. In careful detail he traces the growth of foreign and national airlines in Mexico, Central America, and South America with buttressing tables of operating figures and maps. Particular emphasis is given German activities and the establishment of routes by PAA.

Concerning future expansion, Mr. Burden holds that "it is essential that United States competition be both limited and controlled, since there are few Latin American routes which have sufficient potential traffic to support two United States lines in addition to the European and local companies which are certain to be operating there." To prevent stagnation of air commerce and passenger inconvenience, he thinks that "possibly the whole thorny problem of operating rights for international lines may be solved after the war by world-wide adherence to the principle of freedom of the air for the commercial aircraft of all nations."

NATIONAL EMERGENCY STEELS. American Society for Metals, Cleveland, 72 pages, paper-bound, illustrations, 50c.

Given here are engineering data and performances of steels developed to meet shortages of alloying elements.

THE MODEL PLANE ANNUAL 1943, edited by David C. Cooke and Jesse Davidson. Robert M. McBride, New York. 224 pages, illustrations, $2.50.

For the country's 3,000,000 model plane fans this is the geography complete. It is bursting with photographs and drawings on two main themes: The construction and exhibition of models and their use in wartime. Opportunities to participate in government building projects are outlined, but emphasis is on the planes themselves—their history, engines, and various designs, with tips on tools and methods of working with model materials.

FUNDAMENTALS OF STRESS ANALYSIS, VOL. I, by Albert Deyarmond and Albert Arslan. Aero Publishers, Glendale, Calif. 256 pages, diagrams, appendix, index, $3.

For students familiar with elementary drafting, blue print reading, elementary trig, and basic calculus, this text covers types of structures, stress and strain, forces, axial loads, torsion, and allowable stresses. The material was used by the authors in the defense training program.

THE LUFTWAFFE: ITS RISE AND FALL, by Hauptmann Hermann. G. P. Putnam's Sons, New York. 300 pages, bibliography, $3.

Hauptmann Hermann, according to the introduction to this book by Curt Riess, is the pseudonym of a man whose real name is "well-known in aviation circles in Germany." He emigrated just before the war and is now working in an American aircraft factory. During the last war he was a German pilot, and after the Armistice he took up gliding, then worked for Hugo Junkers. His subsequent connection with German aviation is less clear, but it appears that he became well acquainted with the men who sowed the seeds and reaped the Luftwaffe. By sketching their personalities and aims, he has produced a meticulous and absorbing study of Germany's rearming in the air and the subsequent failures of the program.

When the Nazis "arrived" in 1933, says Hermann, Germany already had a "well-balanced aviation system which was among the best and most modern in the world." Hitler proceeded to build it into a "political weapon", and then there were conceived "self-contained, autonomous units, organized and administered as army units, to be mobilized as air fleets."

Because Germany did not have resources for a long war, the Luftwaffe was designed for blitz-krieg, and in Mar. 1939 it boasted 6,000 first-line planes, which later appeared to comprise invincible support for the Nazi ground forces. But the air war was lost at Dunkirque. There the Luftwaffe failed to smash an operative enemy force. The subsequent Battle of Britain was not won because the Nazi commanders, who admired Douhet, had not developed his keystone, heavy bombers.

THE WRIGHT BROTHERS, by Fred C. Kelly. Harcourt, Brace, New York. 340 pages, illustrations, index, $3.50.

With the approval and assistance of Orville Wright, Mr. Kelly has told the story of the infant airplanes—from conception to the first war—against a background of the traits and characters of the two inventors.

"From earliest years both Wilbur and Orville Wright," he says, "were motivated by what Thorstein Veblen called the 'instinct of workmanship.'" If they had wanted money, Orville said, they would have "tried something in which the chances of success were brighter." Fame did not attract them, but knowledge did. "We were lucky enough," Orville recalls, "to grow up in a home where there was always much encouragement to pursue intellectual interests, to investigate whatever aroused curiosity."

At the time, however, the rest of the world was disinterested. Then a young reporter, Author Kelly didn't bother to go eleven miles out of his way for the story, and a newspaperman who sent an eyewitness account of later Kitty Hawk flights to a magazine was told that his manuscript did "not qualify either as fact or fiction."

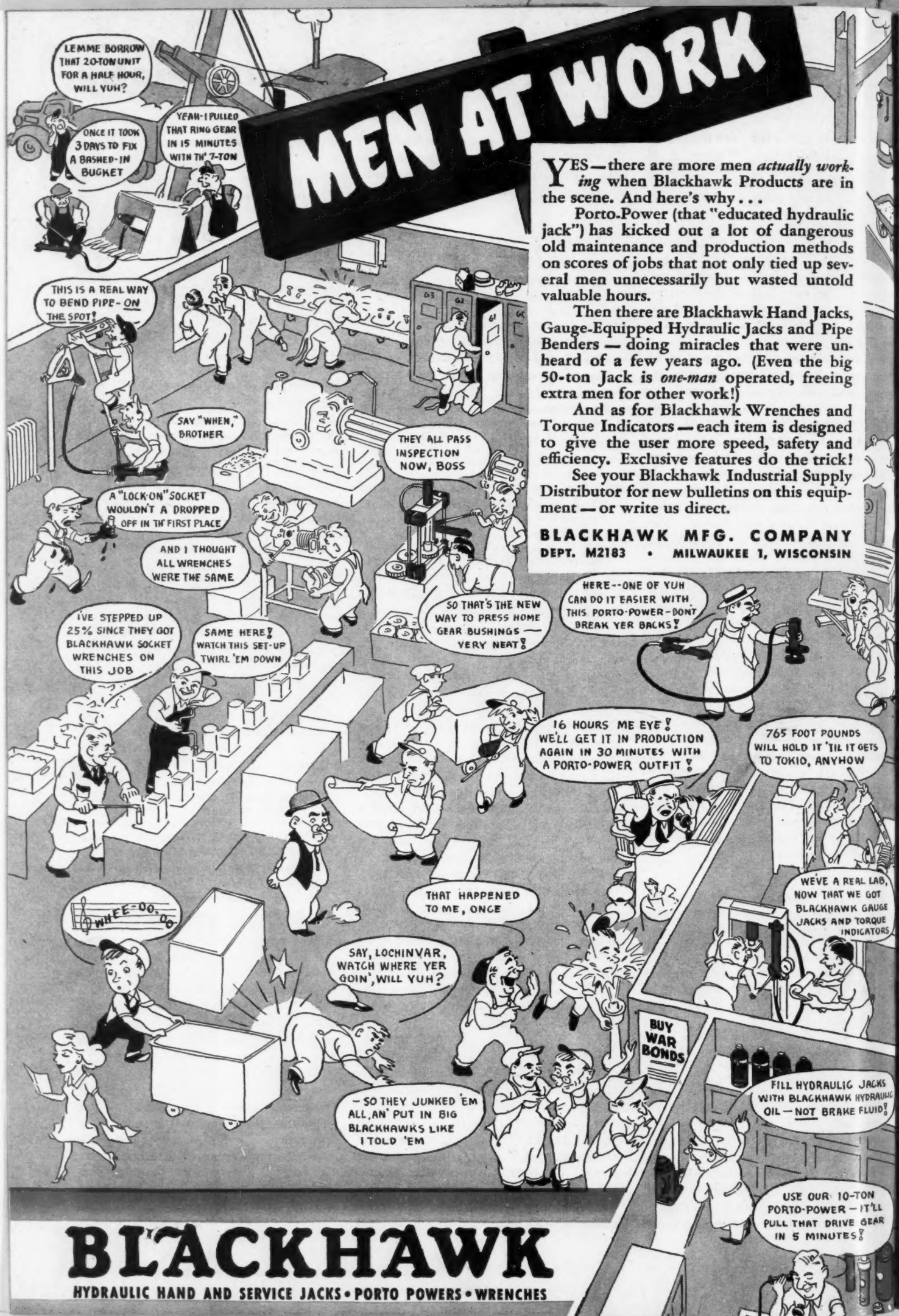
Last to be convinced was the Langleyphile Smithsonian Institution. Upon evidence submitted by Mr. Kelly for Orville Wright, it admitted—last October—that it would be glad to have "the Kitty Hawk machine to which all the world awards first place."

SYMPOSIUM ON RADIOGRAPHY. American Society for Testing Materials, Philadelphia. 256 pages, illustrations, $4. ASTM STANDARDS ON PLASTICS. 384 pages, illustrations, $2.

Thirteen papers presented at the 1942 ASTM symposium on radiograohy form the major portion of this first book and cover such subjects as inspection of welds, magnesium aircraft castings, portable X-ray units, and film evaluation. Also included are condensations of papers from the 1936 meeting and a proposed recommendation of terms.

The plastics publication contains 71 specifications, test methods, and definitions on various types of compounds including phenolic, polystyrene, urea-formaldehyde, and cellulose acetate as well as procedures for determining arc and chemical reagent resistance, compressive strength, distortion, punching quality, and shrinkage.

(*Turn to page* 339)


MEN AT WORK
LEMME BORROW THAT 20-TON UNIT FOR A HALF HOUR, WILL YUH?
ONCE IT TOOK 3 DAYS TO FIX A BASHED-IN BUCKET
YEAH-I PULLED THAT RING GEAR IN 15 MINUTES WITH TH' 7-TON
THIS IS A REAL WAY TO BEND PIPE-ON THE SPOT!
SAY "WHEN," BROTHER
THEY ALL PASS INSPECTION NOW, BOSS
A "LOCK-ON" SOCKET WOULDN'T A DROPPED OFF IN TH' FIRST PLACE
AND I THOUGHT ALL WRENCHES WERE THE SAME
I'VE STEPPED UP 25% SINCE THEY GOT BLACKHAWK SOCKET WRENCHES ON THIS JOB
SAME HERE! WATCH THIS SET-UP TWIRL 'EM DOWN
SO THAT'S THE NEW WAY TO PRESS HOME GEAR BUSHINGS — VERY NEAT!
HERE--ONE OF YUH CAN DO IT EASIER WITH THIS PORTO-POWER-DONT BREAK YER BACKS!
16 HOURS ME EYE! WE'LL GET IT IN PRODUCTION AGAIN IN 30 MINUTES WITH A PORTO-POWER OUTFIT!
765 FOOT POUNDS WILL HOLD IT 'TIL IT GETS TO TOKIO, ANYHOW
WHEE-OO, OO
THAT HAPPENED TO ME, ONCE
WE'VE A REAL LAB, NOW THAT WE GOT BLACKHAWK GAUGE JACKS AND TORQUE INDICATORS
SAY, LOCHINVAR, WATCH WHERE YER GOIN', WILL YUH?
BUY WAR BONDS
FILL HYDRAULIC JACKS WITH BLACKHAWK HYDRAULIC OIL — NOT BRAKE FLUID!
— SO THEY JUNKED 'EM ALL, AN' PUT IN BIG BLACKHAWKS LIKE I TOLD 'EM
USE OUR 10-TON PORTO-POWER — IT'LL PULL THAT DRIVE GEAR IN 5 MINUTES!

YES—there are more men *actually working* when Blackhawk Products are in the scene. And here's why . . .

Porto-Power (that "educated hydraulic jack") has kicked out a lot of dangerous old maintenance and production methods on scores of jobs that not only tied up several men unnecessarily but wasted untold valuable hours.

Then there are Blackhawk Hand Jacks, Gauge-Equipped Hydraulic Jacks and Pipe Benders — doing miracles that were unheard of a few years ago. (Even the big 50-ton Jack is *one-man* operated, freeing extra men for other work!)

And as for Blackhawk Wrenches and Torque Indicators — each item is designed to give the user more speed, safety and efficiency. Exclusive features do the trick!

See your Blackhawk Industrial Supply Distributor for new bulletins on this equipment — or write us direct.

BLACKHAWK MFG. COMPANY
DEPT. M2183 • MILWAUKEE 1, WISCONSIN

BLACKHAWK

HYDRAULIC HAND AND SERVICE JACKS • PORTO POWERS • WRENCHES

Needed . . . A Plant Re-Conversion Cost Policy

(*Continued from page* 127)

position will most likely be sorely strained. With working capital at low levels, it will be difficult to develop many peacetime projects.

It is interesting to note that one major industry (the railroads) is utilizing this area of war-inspired business activity to substantially bolster its financial position for the period to come. In 1942 some $428,325,000 long-term debt, short-term loans, equipment obligations, etc., were paid off, according to statistics filed by the Bureau of Railway Economies in connection with Interstate Commerce Commission hearings on proposed rate increases several months ago. The expectation is reasonable that this year's aggregate will be larger.

The Revenue Act of 1942 paved the way for accelerated debt reductions; first, by permitting bonds selling in the open market at a discount to be bought up by the issuers without considering the difference between purchase price and par as taxable profit; and, second, if the debtor company was subject to excess profits taxes and retired debt up to an amount equal to 25 percent of its excess profits taxes, said debtor company could get an immediate cash credit on its excess profits tax bill equal to 10 percent of its excess profits taxes, or to 40 percent of its debt reduction, whichever was the lower.

This provision applied to last year's rail profits; presumably it will be retained in whatever changes the law may carry if revised this year—and the railroads are acting accordingly.

In other words, through a special provision in the tax law, the rail carriers were able to retire, during a one-year period, a principal amount of debt *in excess of the entire invested capital of the aircraft manufacturing industry.* (This excludes the automobile companies and similarly related enterprises.)

Such debt reductions will leave the railroads with an immeasurably strengthened financial house after the war. Under present conditions, however, it is difficult to say the same for the aircraft builders.

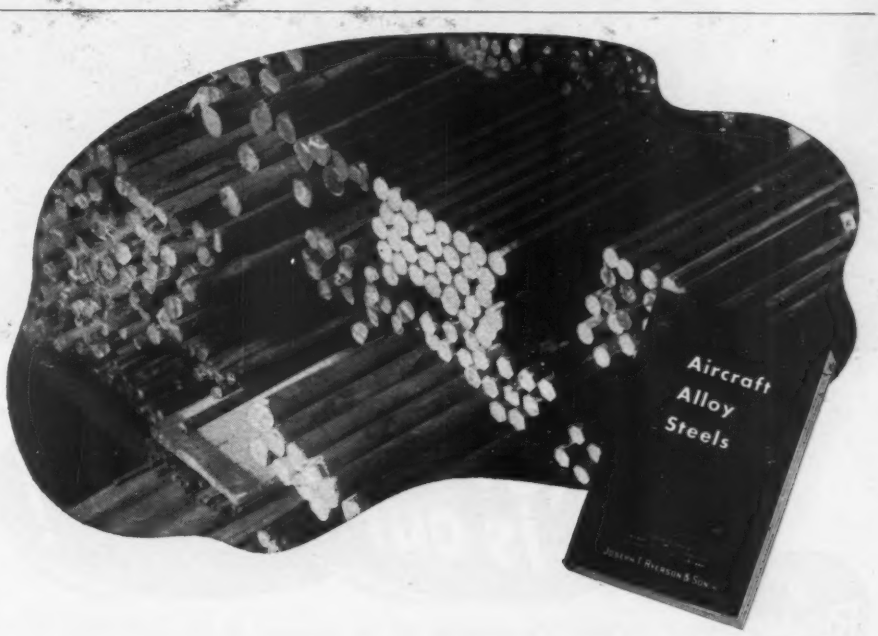
The capital structure of the aircraft industry is such that it has no special fixed obligations or financial ailments of long standing that can be permanently eliminated in the current period of high business prosperity. A few companies have retired part of their preferred stock issues—notably United Aircraft, Consolidated Vultee, and Republic Aircraft. While this trend will probably continue, the senior issues that can be retired in the aircraft industry as a whole are definitely limited.

Certainly, if the railroad industry can have its special problems recognized by Congress, there is little reason not to expect the same for the aircraft industry.

The chairman of the War Department Price adjustment board has indicated that his agency can do nothing for companies which are asking that some provision be made for postwar reserves when their contracts are being renegotiated. Congress, it was asserted, must give a tax status to such reserves first.

The board chairman further expressed the opinion that industry is inclined to overlook the provisions now available for dealing with the postwar re-conversion problem. These are: First, the old termination clause in contracts and the new one in preparation which puts the responsibility on the government for taking care of inventories of finished and unfinished goods at the end of the war; second, the postwar credit in the excess profits tax; and third, the "roll-back and carry forward" provision put in the Revenue Act last year.

There is also the danger, according to the same authority, that a provision for postwar reserves for government contractors will bring a charge



Aircraft Alloy Steels
8630—X4130—4140

Send for an Aircraft Alloy Stock List

Ryerson now offers from stock an even wider range of sizes in Aircraft Alloy Steel Bars. Stocks at Chicago, St. Louis, Cincinnati and Jersey City include the above steels conforming respectively to the following specifications: AN-S-14, AN-QQ-S-684 and AN-QQ-S-752. These stocks are earmarked for distribution under the government's ACW program. A special stock list, helpful to users of aircraft steels is available for the asking.

In addition to Aircraft Alloys, ten Ryerson plants carry stocks of over 10,000 different kinds, shapes and sizes of steels to meet your every requirement.

Call your near-by Ryerson plant . . . whenever you need steel. JOSEPH T. RYERSON & SON, INC., Plants at: Chicago, Milwaukee, St. Louis, Detroit, Cleveland, Cincinnati, Buffalo, Boston, Philadelphia, Jersey City.

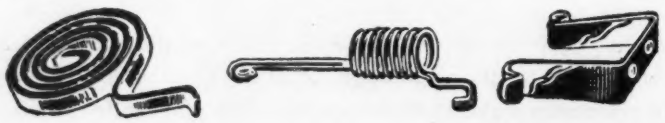
RYERSON

VICTORY is our Business!

Reliable AIRCRAFT QUALITY

We at Reliable are devoting all our energies to the production of vital springs of every type for aerial combat equipment, ordnance, ammunition, and other machinery of war. We are proud of our capable organization, and particularly of our many women workers who have stepped into the places of men entering the armed services. Of such is the stuff of Victory, on the home front, made.

Yes, Victory is our business now—just as it is yours, whoever you are. The better, and the sooner, each Reliable spring fulfills its duty in our vast war program, so much nearer are we all to the day when peace again rules the world. When that time comes, Reliable *finer* springs stand ready to serve you as faithfully for the needs of peace as they have for those of war.



Send us your specifications and drawings.

THE RELIABLE SPRING & WIRE FORMS CO.

3167 Fulton Rd., Cleveland, O. *Representatives in Principal Cities*

YOU CAN RELY ON Reliable Springs

ROUND AND FLAT WIRE SPRINGS · CLIPS · HOOKS · BENDS · LIGHT STAMPINGS

of favoritism from companies which have been forced to the wall by the war. It was further asserted that industry has always had an obligation to provide for future eventualities out of tax-paid funds and that it is not necessary to pay out all earnings to stockholders.

The last statement, as far as it may pertain to dividend payments, may be true with a good many industrial companies, but is in decided variance with the actual financial policy pursued by the aircraft group as a whole. If anything, current dividend payments by the aircraft producers are lower than a year ago.

While no simple solution is readily available that will satisfy all interested parties, a sound policy is strongly indicated for the handling of contract terminations, postwar reserves, and related factors, so that the aircraft industry may successfully meet its future responsibilities.

War Communique No. 20

(*Continued from page* 113)

now? Or are they taking it in the manner they formerly dished it? The history books will tell.

Nazi propaganda already indicates that, when the time comes, a "poor Germany" campaign will be set afoot. Therefore, if you have tears to shed as Antony said at Caesar's funeral, prepare to shed them—at the front bench with those who will plead for the people versus their wicked rulers. And incidentally, now that we have long range airplanes, on the day that the Axis is certain the battle is "no go," the head men of Germany and Italy may be expected to beat it for neutral ground, there to be interned in lifelong comfort. This, if it happens, may bring a grim rush on the Allied box office by multitudes who have been paying their 20 percent tax to see the lot of them hanged.

In the Far East, we have at least status quo-ed the Japs. Tojo may make his little drives, but it's much doubted that he now retains the reach to hit Australia, Hawaii, or the United States successfully. We may grab another island now and then—a blood-sweating job that is much to be praised. But seizures made at this writing merely snub-back the Nips and protect our routes to Australia. Our high commanders themselves have said that there's little logic in going to Japan by the island route. There are hundreds of islands. Ask the responsible men, as the editors of these pages have done, and they will tell you that the Japs just have to wait for their real beating.

We could put bombers in China that

The T&B *STA-KON*

DISCONNECT SPLICER

Quick Facts for the Critical Aircraft Engineer

Made for wire sizes No. 22 through No. 10 Aircraft. Designed for the quick connecting and disconnecting of aircraft wiring, either at time of assembly, or when in service. ¶ Strong, lightweight, highly conductive. ¶ Approved. ¶ Can be connected or disconnected countless times without impairing its electrical or mechanical characteristics. ¶ Disconnects at approximately 15 pounds pull. ¶ Because both tips are identical, there can be no confusion in assembling. ¶ Being solderless, this T & B Splicer installs fast with regular Sta-Kon Pressure Tools. ¶ Synthetic sleeves, solid black or transparent, are available. ¶ Insulators are light weight, very flexible, and possess high dielectric and mechanical strength.

The dependability of the Disconnect Splicer under severe service conditions is due to its slotted coupler section—a high tension alloy spring. Due to the pressure of this essential spring, tips are in firm, constant wide-area contact.

SOLD ONLY THROUGH RECOGNIZED T& B ELECTRICAL WHOLESALERS

Send for newly revised Aircraft Catalog No. 36 for full technical data on equipment designed for the Aircraft industry.

THE THOMAS & BETTS CO.

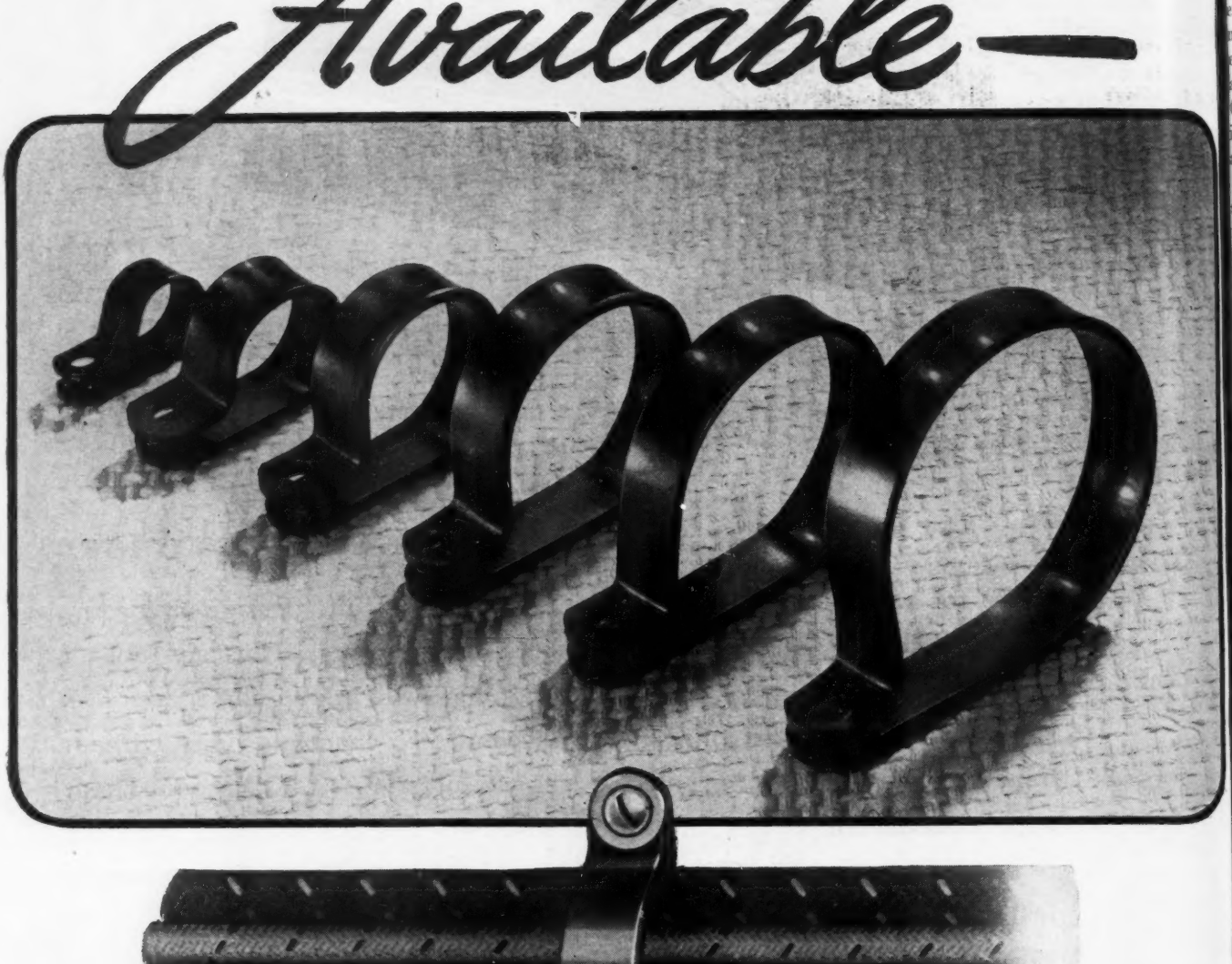
INCORPORATED

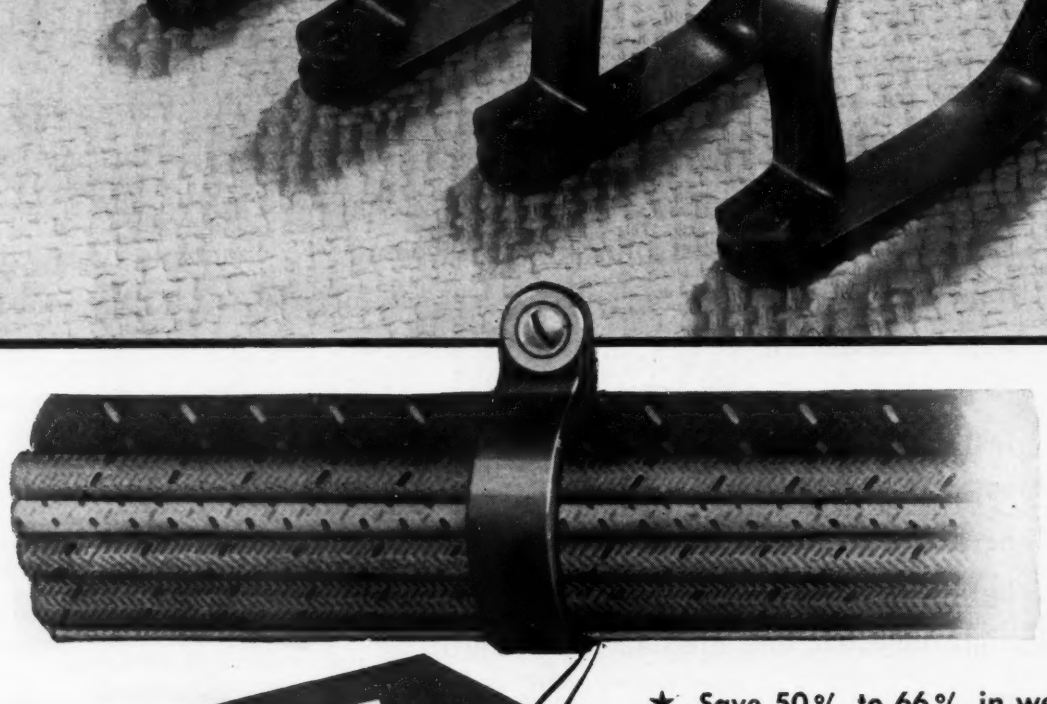
MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1899

ELIZABETH 1, NEW JERSEY

In Canada: Thomas & Betts Ltd. Montreal

Available—





BURNDY
Versiflex
CABLE HANGERS
(BUNDLE CLIPS)

★ Save 50% to 66% in weight
★ High dielectric strength
★ Good mechanical strength
★ Conserve critical metals
★ As per AC 755 Specification
★ Self insulating . . . available now

—already in use on military planes. Complete information from the Burndy representative near you . . . or direct.

BURNDY ENGINEERING CO., INC. • 107 EASTERN BOULEVARD, NEW YORK 54, N. Y.
ELECTRICAL CONNECTORS—VERSIFLEX CABLE HANGERS AND TUBING

could easily hit Japan, but not consistently without the necessary huge stores of gasoline, equipment, and all the rest. Nothing can get there now, except by airplanes crossing 16,000-ft. mountains from India and carrying enough gasoline to get themselves out again. That flying man's run into Cathay is so tough and dangerous that it makes a trans-Atlantic hop seem like a Sunday afternoon joyride.

In the Aleutians, Kiska remained the single Jap foothold on American terrain. As this was written, it was getting a double-plus softening up.

The Japs planned an effective war. They knocked out half of our capital fleet in about 20 min.; they pushed the British down the Straits and took Singapore, whose guns pointed the wrong way; they captured a magnificent empire in the Philippines and the Indies; and they caught the Russians, who alone were close enough to sock them, otherwise engaged.

But they made mistakes, too. They underestimated the time of our recovery from the Pearl Harbor Sunday punch; they miscalculated the ability of the English to stay in India and turn it into a base of operations; and worst of all they bet on the wrong horse in the big-money race. Hitler was touted to win, but he is losing.

As we have said before, an enormous amount of war-making gear will be free for action on the Japan front when the Nazis fold. There have been no figures for a long time on Japanese aircraft production. Reports never did agree. You can only guess for yourself. But if the Germans had 10,000 combat planes at their fronts, half of them in reserve, the Japs have had less. The reasoning is that they never show up in action with nearly as many planes as the Germans do. Most important: No matter how many they have it won't be enough. For we will have tens of thousands, pulled out of Europe, out of transit, and out of our factories and British factories, maybe out of Russian factories eventually, too. One officer, whose opinion is worth something, said he thought it would take six months to move our shooting equipment and camp outfits over there and get ready for action. That does not include the job of fighting our way into the jumpoff places, precise layout of which is all problematical now because we don't know what Russia will do. Of course the British and American navies combined can plow through the Japs, but considerable losses would have to be expected in mined waters and against Hiro's shore-based planes. Our commanders want to do it the life-saving way if they can.

Here on the home front, aviation is a major consideration, just as it is on the war fronts. To put it in a quick

— USE QUALITY

DARNELL CASTERS

—it pays to "Demand Darnell Dependability".

Darnell Dependability assures savings, service, safety, speed. A caster or wheel for every use.

Recognized Standard of Quality

★ ★ FREE MANUAL ★ ★

A SAVING AT EVERY TURN

DARNELL CORP. LTD., 60 WALKER ST., NEW YORK, N.Y.
LONG BEACH, CALIFORNIA, 36 N. CLINTON, CHICAGO, ILL.

summary: People have gone nuts about helicopters, even girls in offices—and for all we know, rightly so . . . . It looks as if renegoiation of contracts is going to skim off the profits from aircraft production as long as the war lasts, thus playing havoc with intentions of accumulating reserve funds . . . . All ground transportation—bus, railroad, and steamship lines—are going after the Civil Aeronautics Board and Congress with hammer and tongs for rights to establish air services of their own, although the present law says they can't do it . . . . The House Commerce Committee, busy redrafting the Civil Aeronautics Act since last February, has been forced by pressure groups to pull many of the bill's new teeth, and still hasn't made a report. There will be a honey of a fight about this bill next fall . . . . Schemes for liquidating the vast fleet of cargo airplanes that will be owned by the Army and Navy when peace comes, are beginning to rattle around in Washington's head. And schemes for liquidating the vast plants that are building warplanes also are being concocted, promising some terrible headaches.

In closing: If you have information about new military airplane development work, keep it under your scalp. The Army and FBI mean business in their current drives against the lunch hour confidence men.

Five Brothers*..

..and an Idea

It isn't often that an idea created in the minds of boys will materialize in later life. With the five Turner brothers, William, Cort, Frank, Charles, and Robert, their boyhood idea that some day they would be in business together, overshadowed all the obstacles of hard work, and study to make this idea a reality. ★ Finally in April 1939 they purchased their first grinding machine and formed their own company. From this modest beginning they gradually won recognition among manufacturers for precision-built gauges. This recognition made expansion necessary, and today their company occupies one of the most modern buildings for the manufacture of gauges in the country. ★ The TG stamped on a gauge represents a product backed by the integrity of five brothers and their practical knowledge of precision gauges.

**Since May 7, 1942, William Turner, of the U. S. Navy, has been reported missing in action in the Coral Sea Battle.*

The Stamp TG of Precision

TURNER GAUGE GRINDING COMPANY

2627 HILTON ROAD . . FERNDALE, MICHIGAN

Sheet-Spring Fasteners Speed Assembly

(*Continued from page* 185)

the assembly may then be completed without holding the nut.

Switches inside switch boxes on the North American B-25 *Mitchell* were formerly fastened in place with brass nuts brazed into position. Eighteen nuts were used which required as many brazing operations. To save all this work, the brass nuts were replaced with "J" type nuts which are readily snapped into place over the screw holes, as shown in Fig. 2.

Again to save assembly time, the two resisters are being fastened in place with four standard Speed Nuts, as well as the box cover which is fastened to the hinge with five nuts. All of these nuts provide a double, spring-tension lock which prevents vibration loosening.

To simplify and speed up cable assembly in the Bell *Airacobra* and other fighters, a new cable clip was adopted which did not require bolts, screws, rivets, or the use of any tools. Only a pre-punched hole in the structure is needed. Shown in the first photo of Fig. 3 is the manner in which the integrally formed lip of the clip is slipped into the hole in the structure. The lip is then pushed downward and forward until the catch snaps into the hole, locking the cable clip firmly in position. The second picture finds the assembler snapping the cable into the clip, and finally the completed assembly within the plane is seen.

Where desired, the cable clips are furnished with Neoprene cushion coatings. Not only does this clip reduce original assembly time but it also permits instant removal of cables for servicing. Removal of the clip is accomplished by merely sliding a simple tool under the clip and pressing back until the lip disengages. As a time and part saver, these cable clips are as efficient as the harness clamps.

As quickly as plywood came into use in gliders and other aircraft, the company's development engineering department brought out a nut that locks itself in place before the screw is applied. Able to be instantly driven into anchored position, this nut for plywood has the same basic prongs to fit various screw threads. It also has two pairs of attaching legs. When used in thick plywood, the cam-like structure of the attaching legs forces them outward as they are driven deeper—permanently

PRESSTITE

EXTRUDED SEAM SEALING TAPE Seals Intercooler and Air Ducts of Lockheed's P-38 "Lightning"

Another leading aircraft manufacturer using Presstite Sealing Compounds is Lockheed—for Presstite Extruded Seam Sealing Tape is used to seal the intercooler and air duct of the P-38 "Lightning."

Other Presstite Compounds are in use for a variety of aircraft sealing purposes, providing a thoroughly proven method of assuring better sealing jobs with a saving in labor and time. Such applications include the sealing of:

- Riveted Fuselage Seams
- Drop-off, Expendable Fuel Tanks
- Instruments
- Seaplane Floats
- Integral Fuel Tanks
- De-Icer Tanks
- Synthetic Glass Enclosures
- Gun Turrets
- Insulation of Dissimilar Metals

If you are faced with any sealing problem in your plant, Presstite's specialized knowledge of this field may well prove of valuable assistance. Send us your detailed specifications and requirements, and we'll gladly recommend the best Presstite Sealant for your particular needs.

Presstite Products for War: Aircraft Sealers, Marine Coatings and Cements, and many other Special Products for the Army and Navy.

Presstite Products before Pearl Harbor: Sealers for the Refrigeration Industry, Railroads, Industrial Plants, Sewer Construction.

PRESSTITE
SEALING COMPOUNDS

PRESSTITE ENGINEERING COMPANY, 3910 Chouteau Ave., St. Louis, Mo.

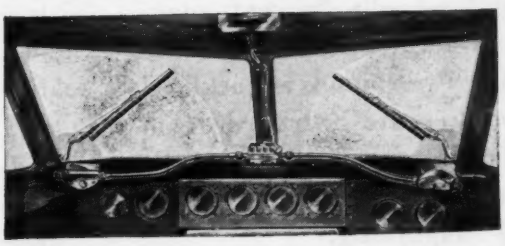
CLEAR OBJECTIVE

Rain or Shine

•

Marquette

All-Weather Windshield Wiper



• 'Round the clock, the bombing of our enemies must continue. In rain and sleet, the Marquette Windshield Wiper provides clear sight for pilot and bombardier, an important factor in the fight to Victory!

The Marquette

METAL PRODUCTS COMPANY

Cleveland • • • • Ohio

holding the nut with a spring-tension grip in the wood. When driven into thin plywood, the attaching legs "peen" over against a backing plate.

To compensate for misalignment of holes, a variation of the same principle is used. Here, a retainer bracket has the same attaching legs but the main base has a round hole over which a "U" nut is snapped, having most any degree of float desired. These nut fastenings for plywood are extremely light in weight, running only 3½ lb. per thousand on the standard type and slightly more with the floating type.

The large bearing surface spreads the load over a greater area. This is especially advantageous in plywood or laminated plywood assemblies. Both assembly time and weight savings are important advantages gained in the use of this nut on the aircraft assembly lines. These new plywood nuts are made for both Air Corps sheet metal screws and machine screws.

Hundreds of other aircraft fastening devices have been developed on the same basic spring-tension principle, which has revolutionized most non-structural assemblies in all types of aircraft. They even include spring latches for access doors, junction box covers, and hand-hole plates. In many cases 75 percent of the weight was removed and assembly time was reduced to less than 30 percent of the former methods.

Keynote of the system is the building of fastenings from coiled spring-steel stock on high speed precision machines. The engineering thought has centered on simplification and elimination of parts while at the same time conquering the vibration factor. Meanwhile, new fastening developments are constantly coming from the company's elaborate development engineering department, which has already solved hundreds of aircraft fastening problems.

Super Aluminum Alloys For Aircraft Structures

(*Continued from page* 163)

Consolidated Vultee Pre-Stretch Studies

Since the writer covered in a previous paper[2, 11] the results of research carried on by the San Diego Engineering Test Laboratories up to 1941 in the application of pre-stretched material to large aircraft being produced at that time in the San Diego area, only a brief review of those findings is necessary here.

In the current design period, when yield point properties are held as important as ultimate tensile properties, it is obvious that, should the aircraft manufacturers be able to raise the material yield point properties above the

WRIGHT
Aircraft Engines
28 points of contact
The name "Wright" represents the acme of engineering skill in aircraft engine design and production. Outstanding quality is a "must" in every part selected for use in a Wright engine.
Auburn
CERAMIC SPARK PLUG CONNECTORS
were selected for use in Wright engines after exhaustive tests. The selection is a tribute to the value of Auburn Connectors in maintaining constant contact. Auburn Connectors do not carbon-track, carbonize or absorb moisture.
Write us for information.
AIRCRAFT DIVISION
AUBURN SPARK PLUG COMPANY, Inc.
1180 Raymond Blvd. Newark 2, N. J.
ACTUAL SIZE
AUBURN
No. 1099
1 Inch
AUBURN SPARK PLUG COMPANY, Inc.
MAIN OFFICE and FACTORY, AUBURN, N. Y.

Arteries for a Fighting Heart!

REX-FLEX Stainless Steel Flexible Tubing is battle-tried and proven—at the heart of the giant motors which power the Boeing Flying Fortress—on equally important applications on many other of our latest, largest and most formidable military aircraft.

In aircraft production the adaptability of **REX-FLEX** for installation facilitates the flow of parts through manufacture to assembly and speeds the convergence of major units into final assembly.

REX-FLEX characteristics of light weight, strength, flexibility, and resistance to corrosion, heat and vibration are solving an ever increasing number of vital problems in aircraft design and construction. Like the accomplishments of the aircraft industry itself, the application developments of REX-FLEX, considered impossible mere months ago, are commonplace production line assemblies of Chicago Metal Hose Corporation.

Write for Engineering Recommendations

CHICAGO METAL HOSE CORPORATION

General Offices: MAYWOOD, ILLINOIS

Factories: Maywood and Elgin, Ill.

minimum guaranteed properties of the material manufacturer, a substantial weight saving might be possible. Especially is this so when test data are required to be corrected down to the minimum properties of the material used.

The benefits of material selection for high average yield and ultimate tensile properties and for process control are exemplified in the 1939 production of the Consolidated Model 31 flying boat. This two-engine "giant," you will recall, had to its credit the use of the most powerful aircooled radial engines of its day and held claims to the longest range and the maximum speed of any similar-sized flying boat of its time. Another "first" possessed by the Model 31 plane, though perhaps not as universally known, was its construction using high-yield 24ST Alclad sheet and pre-stretched stiffeners, from initiation of the engineering design to test flight in less than ten months.

The Consolidated Vultee organization has found, not only in the Model 31 flying boat but also in the mass production of thousands of *Liberator* bombers, that a definite strength-weight gain can be made if controlled and cold-worked material is used in major aircraft structural assemblies. The manufacturing practice used in the San Diego plants in producing stiffeners intended for such structures has been to roll or draw the various shapes from strip stock in the annealed or soft condition. Fig. 4 shows Consolidated Vultee workmen rolling 1½-in. deep hat stiffeners from 24SO strip stock on a 10-stage Yoder machine. Each stiffener length is then heat treated, aged, and stretched sufficiently to leave approximately 3½ percent permanent set, as shown in Fig. 5. The 1½-in. hats are stretched approximately 4 percent to allow for spring-back.

Fig. 6 represents some of the earliest test data collected by the San Diego Consolidated Vultee Laboratories on the effect of the amount of pre-stretch on the properties of drawn ⅞ in. 24ST Alclad zees. In this particular drawn material there was a rapid increase in the PEL. and YP. in tension produced by pre-stretching up to approximately 6 percent, followed by a general flattening to 9 percent.

It will be noted that the ultimate compression stresses obtained from 14-in. long flat-ended specimens, consisting of three ⅞ x .051 in. drawn Alclad zees riveted at 4-in. spacing to 0.040-in. 24ST sheet, dropped slightly during the initial 1 percent pre-stretch and then rose again until the compression allowable after a 4 percent pre-stretch again equalled that of the unstretched material. At 9 percent pre-stretch, the sheet-stiffeners gained approximately 15 per-

8 Miles up to the Stratosphere go Lockheed "Lightnings"

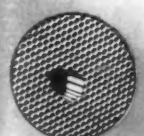
Their Engine Cooling Systems SAFE . . . from freezing, clogging, leaking or over-heating

Up, up, they go, where even the highest-flying bombers cannot . . . then down from the clouds they come—like forked vengeance. How can they do it—and stay in one piece? Design and engineering providing *extra* strength and dependability is the answer. Their engine cooling systems, for example, are equipped with Winchester Cartridge Core Tube Radiators.

Made of pure copper, with walls only 6/1000ths of an inch thick, Winchester Radiator Tubes, thanks to Winchester's COLD copper-extrusion process, are seamless and so assembled that *their entire outer surface is cooling area.*

WINCHESTER RADIATOR TUBES RESIST CORROSION . . . DEFY BURSTING. Pure copper, Winchester Cartridge Core Tubes will not corrode under regular operating conditions. And they won't burst from freezing, because the coolant flows on the *outside* of the tubes. If freezing should compress a tube, causing a "set" and so restricting air flow, passing a rod through it restores it to normal shape.

IF WOUNDED THEY QUICKLY FLY AGAIN. Pictures below show how to replace Winchester Cartridge Core Tubes should they be punctured in action or by accident. They explain, too, why millions of Winchester Cartridge Core Tubes are used to keep planes and tanks in constant action.



DAMAGED TUBES ARE PUSHED OUT

NEW TUBES ARE INSERTED

SOLDERING COMPLETES REPAIR

WINCHESTER REPEATING ARMS COMPANY
New Haven, Connecticut
Division of WESTERN CARTRIDGE COMPANY

WINCHESTER

TRADE MARK

"On Guard for America Since 1866"

COPR., 1943, WINCHESTER REPEATING ARMS CO., DIVISION OF WESTERN CARTRIDGE CO.

HARDER JOBS WANTED FOR THESE SENSATIONAL TUBES

No War Baby, Winchester Cartridge Core Tubes have 25 years of service behind their performance. They offer these spectacular features:

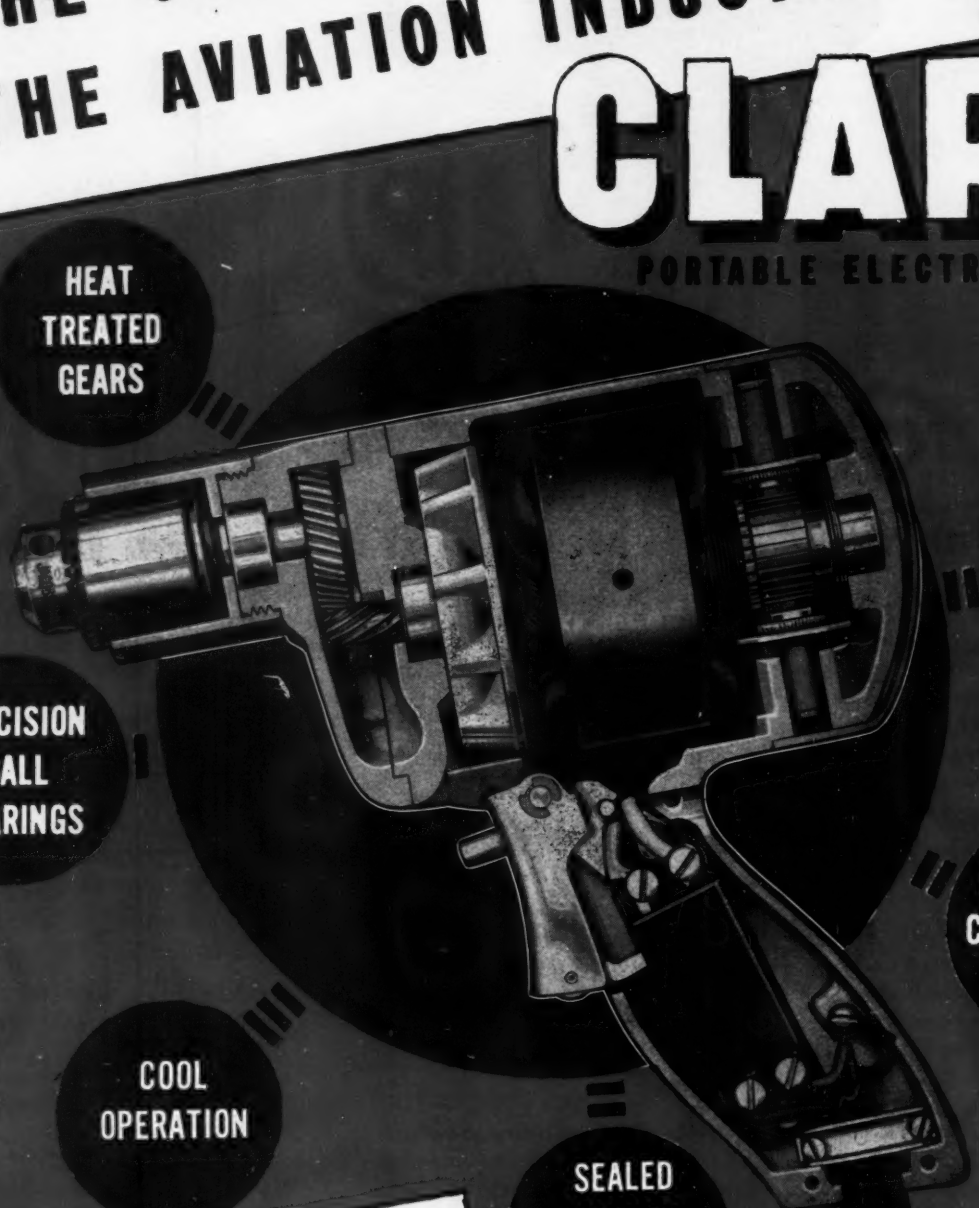
- Of pure copper, thus corrosion-proof.
- Seamless,—safe against leaks.
- Coolant on *outside* — no damage from freezing.
- 1,728 cartridge core tubes per square foot.
- Avoid waste space in radiator assembly—minimum of solder.
- Permit tailoring radiator, to fit any dimension or design.
- Provide up to 25% greater cooling per square foot than others.

If out of your engineering knowledge, experience, research and skill you are contemplating a new fighting machine for Uncle Sam . . . are dreaming up a startling new post-war automobile, or similar product, write Radiator Division, Winchester Repeating Arms Company, New Haven, Connecticut.

THE *Workhorse* OF THE AVIATION INDUSTRY

CLARK

PORTABLE ELECTRIC DRILLS



HEAT TREATED GEARS

CLARK UNIVERSAL MOTORS

PRECISION BALL BEARINGS

AIR SEALED COMMUTATOR CHAMBER

COOL OPERATION

SEALED SWITCH COMPARTMENT

"The James Clark, Jr. Electric Company are also manufacturers of grinders and sanders. These too, are produced under the Controlled Construction Method.

Since 1892 when Clark first started manufacturing electric tools, constant field tests plus long engineering experience have resulted in that they can proudly say, "First In The Field—First With Portable Drills, First With Improvements, First in Quality".

"KEEP BUYING" WAR SAVINGS BONDS AND STAMPS

JAS. CLARK JR. ELECTRIC CO.

606 BERGMAN ST.

LOUISVILLE, KENTUCKY

cent in ultimate compression stress over that of the untreated combinations. As for the 3½ percent pre-stretch condition, since chosen as standard by Consolidated Vultee, the physical properties will be noted in the table accompanying Fig. 6.

Cold-Working 24ST Extrusions

Mitchell,[12] in a recent article, has presented the results of tests on cold-worked 24ST aluminum alloy extrusions made in the CVAC Laboratories some years ago. He has shown that in 24ST extrusions, as in the drawn 24ST shapes just discussed, pre-stretching increases the tensile ultimate somewhat and increases the compressive and tensile yields a considerably greater percentage. A typical example was the 1½ in. deep by .078 in. 24ST extruded hat which, when heat-treated and aged for three days, had a tensile ultimate of 71,000 psi., a tensile yield of 46,700 psi., and a compressive yield of 45,700 psi., as shown in Fig. 7. After 0.6 percent pre-stretch, this same material exhibited properties of 71,500 psi., 52,500 psi., and 45,700 psi., respectively.

Again you will notice the rapid increase in tensile yield stress with little change in compression yield stress at small values of pre-stretch. At 3.5 percent permanent set due to pre-stretch, however, the tensile ultimate increased to 75,500 psi., the tensile yield to 62,500 psi., and the compressive yield to 50,700 psi. This 3.5 percent pre-stretch therefore increased the original 24ST extrusion mechanical properties at tensile ultimate 6 percent, at tensile yield 34 percent, and at compressive yield 10 percent, a worthwhile gain when it is considered that the stretching of this extrusion to approximately 1 percent permanent set, following its heat-treatment, was necessary to straighten the member. The increased properties due to the controlled 3.5 percent set were therefore a gift, with the expenditure of almost no effort or production time.

CVAC Compression Test Methods

Inasmuch as considerable of the test information, on the compression yield strength of aluminum sheet and shapes, that is being considered in these articles was gained by methods possibly unfamiliar to the reader, a short review of testing techniques is in order:

The conventional manner of compression-testing sheet-stiffener combinations at CVAC is shown in Fig. 8. The specimen, with both ends ground flat and parallel, is placed as a flat-ended panel between hardened plates on the platens of a hydraulic testing machine. The sheet extends over one outer stiffener a distance equivalent to the stiffener spacing and the free sheet edge is restrained by a clamped "split-tube" of steel. The CVAC tests of "one edge restrained" sheet-stiffeners, as seen in Fig. 8, to produce results similar to those just discussed in Figs. 6 and 7 has been found very practical, since these test results may be used as a direct design comparison with stress analyses worked from total wing sectional areas.

This "split-tube" method of support also provides an equal number of panels and stringers—a convenient condition for the determination of the load per panel. The restraining tube, although undercut to prevent contact with the testing machine platens may, nevertheless, if clamped too tightly, produce excessive support to the protruding sheet. Tests have indicated that a "split-tube" clamped on the edge sheet of a three-stiffener flat-ended combination tight enough to produce a small amount of friction gives design data corresponding to an end fixity of 3.0 to 3.5, depending upon the "L/ρ" ratio.

Most modern stress analyses use a design end fixity for wing sheet-stiffeners of 1.0 to 1.5. Since fixities obtained in flat-ended tests are different from fixities obtained in a wing structure, the length of a sheet-stiffener test specimen should be greater than the wing bulkhead spacing when a direct deter-

FOR EYES THAT MUST SEE IN THE DARK

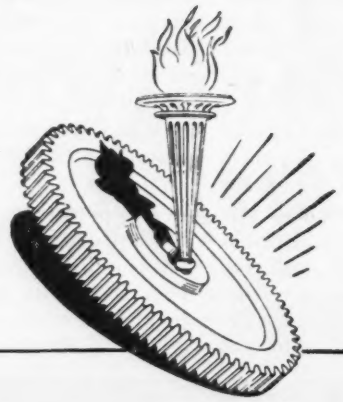
Somewhere tonight over the world's battle fronts American and Allied bombers will cast dark shadows of doom over the military and production installations of our enemies.

Bringing second sight to these eyes which must see in the dark is McAleer's wartime privilege. More and more—night time enemy targets are brought into sharp relief by the brilliance of McAleer military pyrotechnics. These are among the little heard of but vital weapons which are helping step up the tempo of our assault—putting our war effort on a 24-hour schedule—a round-the-clock Drive to Victory.

Military pyrotechnics alone are not all of the war products of the McAleer Company; there are others which extend into the fields of military aeronautics and hydraulics—yes, and embrace our complete industrial finishing facilities as well.

ON THE HOME FRONT we fight the war, too . . . by helping other war plants increase their production . . . by furnishing *quality-controlled* finishing materials and methods which help most industries contribute more to the war effort. If increased finishing efficiency can help YOUR war effort, we suggest you get in touch with us today. Our advisory facilities are at your service.

McAleer MANUFACTURING CO.
Quality-Controlled Finishing Materials
ROCHESTER, MICHIGAN



BUSINESS MUST BE FREE— FOR FREE PEOPLE

★ We in this country have enjoyed the "Four Freedoms" for so long that perhaps we forget the existence of these Freedoms —and their maintenance through the years—has been largely the economic result of a Free Enterprise System.

When business is free to plan ahead, to dare, and to risk with faith in the future—with faith in the possibility of a reasonable profit, all the people benefit! When the imagination and inventive genius of industry can forge ahead with new production methods, develop new products, and invade new markets—then mass employment and the Four Freedoms are assured.

Free Enterprise, spurred on by the Profit Motive, and operating under our traditional American Way of Life, has constantly raised the living standards of millions, created new jobs, kept wages and salaries rising, and cut the cost to the consumer of goods produced.

No dictator ever arose in a healthy, prosperous civilian economy. None ever will. Only industrial stagnation breeds those unhealthy forces of discontent that alone lead men to the destruction of their own Four Freedoms.

Industrial progress promotes Freedom, when industry in turn is free of hampering government regimentation. Government must *encourage* industrial progress, not handicap its development. Repression is foreign to the conception of free people. And, because appreciation comes only from knowledge and understanding, we in Industry must explain these benefits of Free Enterprise to those who may not understand them today.

CURTIS PNEUMATIC MACHINERY DIVISION
of Curtis Manufacturing Company
1957 Kienlen Avenue • St. Louis, Mo.

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

Compressors — Air Hoists — Air Cylinders

mination of the allowable stress is desired. Denoting test values by primes, the wing-structure values by double primes, the following relation between bulkhead spacing and test-specimen length is obtained:

$$L' = L'' \sqrt{C'/C''}$$

in which C' and C'' are the end fixity factors noted above. Hence, for closed stringers where laboratory specimen and wing section failures are of the same type, the ratio is approximately equal to $\sqrt{2}$, or 1.414. In other words, the laboratory test specimen of 28-in. length should give comparable column stresses o a wing section with a 20-inch bulkhead spacing.

Since it is expensive to build and test sheet-stiffener specimens for the sole purpose of determining the compression yield point of material, the aircraft industry has developed such ingenious short cuts as the NACA "pack" method; the Vega "roller" method; the "stringer back-to-back"; and, most recently, the "sandwich" method of testing. Much has been written about the first two methods, and reference need be made only of their existence.

The "stringer back-to-back" method was used in 1939 at the CVAC Test Laboratories to determine material compressive yield. Fig. 9 illustrates the "stringer back-to-back" compression test method for determining the block compression yield properties of some 1½-in. deep extruded hat stiffeners, approximately 5 in- long. The yield point of the material, determined in those days by "Celstrain" gauges or Huggenberger extensometers, was surprisingly consistent. The compression ultimate, however, caused by the instability of the specimen, proved of academic interest only. Fig. 10 illustrates the use of the Templin-type autographic stress-strain recording extensometer on the common edges of two rolled hat-stiffeners riveted together to form a stable column. The use of two small 3-in. long hat-stiffeners such as these did much to simplify and speed up the mass testing of large quantities of control specimens.

Still greater simplicity was achieved in 1942 by the development in the CVAC Test Laboratories of the "sandwich" method of compression yield determination. Greased steel or hardwood blocks lightly clamped over the 3 x 1 in. compression coupon, to the two extending tabs of which is attached an extensometer, give ample support to prevent coupon instability. Fig. 11 shows the "sandwich" method used with the Templin-type extensometer.

Because the compression coupons for this "sandwich" test jig are blanked from sheet stock as readily as are standard tensile coupons, and since only the two narrow 1-in. opposing faces need

Where "Cannibalism" is the only source of spares

Official photo U. S. Army Signal Corps

The record of the men and planes in the Southwest Pacific speaks for itself. With little equipment and spare parts salvaged from ships beyond the patching stage, these flyers have stopped the Japs at every turn.

Bombers and fighting ships have withstood every type of abuse... makeshift landing strips, necessarily limited overhaul and round-the-clock missions.

Every one of these ships has had from hundreds to more than a thousand Fafnir Aircraft Ball Bearings on the control system alone. The record of these bearings in standing up under these extreme conditions and in maintaining responsive, friction-free control is the result of years of pioneering and development work with leading aircraft engineers, starting on plane models of the 1920's.

Whatever the requirements in ball bearings for engines, propellors, controls, landing gear and instruments in aircraft of the future, Fafnir will be ready. The Fafnir Bearing Company, Aircraft Division. New Britain, Connecticut.

Send for copies Fafnir Aircraft Service Manual, you will find it an invaluable service guide.

HOW TO SPEED UP SLOW FINISHING JOBS!

FINISHING A BIG CASTING'S periphery or the interior surfaces of parachute buckles, Metalite Cloth belts or other specialties do war jobs swiftly and expertly; they follow contours so perfectly.

As in the illustrations above, our Abrasive Engineers adapt present machines to new work, either by slight changes or suggesting some simple attachment, to make hard finishing jobs easy, fast, economical.

They'll also demonstrate varied ingenious Metalite Cloth shapes like those below, that production men have nicknamed "Gadgets". One short demonstration on your own work and you'll be using them on high speed tools all over the shop to supplant hand finishing and other slow methods.

This helpful service is yours by simply calling our nearest branch.

Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Grand Rapids, High Point, Indianapolis, Los Angeles, New York, Philadelphia, St. Louis, San Francisco, Tacoma.

BEHR-MANNING · TROY, N.Y.

(DIVISION OF NORTON COMPANY)

grinding flat and parallel, this technique lends itself well to large test programs. This "sandwich" compression test method is now standard in the CVAC Laboratories at San Diego.

References

General Discussions of Aluminum Alloy Physical Properties

(1) Rowland, W. L.—"Variation of the Modulus of Elasticity of Duralumin." **Journal of the Aeronautical Sciences**, Vol. 4, No. 12, Oct. 1937.

(2) Aitchison, C. S., and Tuckerman, L. B.—"The Pack Method for Compression Tests of Thin Specimens of Material Used in Thin-walled Structures." **NACA Technical Report No. 649**, 1939.

(3) Hartmann, E. C.—"Reduction of Test Results to Standard in Aircraft Structural Parts." **Aluminum Company of American Memo. 325-M**, Feb. 7, 1939.

(4) Templin, R. L., and Sturm, R. G.—"Some Stress-Strain Studies of Metals." **Journal of the Aeronautical Sciences**, Vol. 7, No. 5, Mar. 1940.

(5) Jackson, K. R.—"Modern Aircraft Materials and Their Testing,"—paper presented before Society of Automotive Engineers, San Diego, Calif., Apr. 19, 1940. Published in **Aero Digest**, Dec. 1940.

(6) Unpublished **Douglas Aircraft Company Report SM-3311**, "Methods of Correcting Compression Test Results to Minimum Guaranteed Physical Properties," Aug. 1941.

(7) Fischel, J. R.—"The Compressive Strength of Thin Aluminum Alloy Sheet in the Plastic Region." **Journal of the Aeronautical Sciences**, Vol. 8, No. 10, Aug. 1941.

(8) Jackson, K. R.—"Physical Testing Methods for Determining Compression Properties of Sheet Metal." Unpublished **Consolidated Vultee Aircraft Corporation Report No. SG-1013**, Feb. 1943.

Cold Working of Aluminum Alloys

(9) Holt, M., and Hartmann, E. C.—"Increasing the Strength of Aluminum Alloy Columns by Prestressing." **NACA Technical Note No. 618**, 1937.

(10) Jackson, K. R.—"Applications of Cold Working Procedures to Aircraft Structures. Paper presented before American Society for Metals, Los Angeles, Calif., Apr. 19, 1941.

(11) Jackson, K. R.—"Strengtheng Alumnium for Aircraft Structures." **Metal Progress**, July, 1941.

(12) Mitchell, B—"Effect of Cold Work and Heat-treatment on 24S-T Aluminum Alloy." **Journal of the Aeronautical Sciences**, Mar. 1943.

Artificial Aging of Aluminum Alloys

(13) Meissner, K. L.—"The Effects of Artificial Aging upon the Resistance of Super Duralumin to Corrosion by Sea Water." **Journal of the Institute of Metals**, Vol. 45, 1931.

(14) McCreight, R. L., and Jackson, K. R.—Unpublished **CVAC Report No. SG-5**, "Physical Tests of Baked 24S-T Specimens," Apr. 1937.

(15) Howell, P. M., and Stickley, G. W.—**Aluminum Research Laboratories P. T. Report 38-55**, Aug. 1938.

(16) Cohen, M.—"Age Hardening of Duralumin." **Metals Technology**, Oct 1938.

(17) Brahtz, J. F., Weiher, E. R., and Tatman, M. E.—Unpublished **CVAC Report No. SG-675**, "Heat Effect on Physical Properties of 24S-T Aluminum Alloy Sheet," Jan. 1940 and Jan. 1942.

(18) **Air Corps Technical Report No. 4542**, "The Effect of Artificial Aging on the

Tensile and Compressive Properties of Alclad 24S-T Corrugations," — Unrestricted—June 1940.

(19) Tatman, M. E., and Weiher, E. R.—Unpublished **CVAC Report No. SG-884,** "Effect of Heat on the Physical Properties of 24S-T and on the Color of Protective Coatings and Camouflage Finished," Apr. 1942.

(20) Tatman, M. E., and Weiher, E. R.—Unpublished **CVAC Report No. ZM-028,** "Aging of Alelad 24S at 350 deg. F.," June 1942.

(21) Mozley, P. P.—Unpublished **Lockheed Aircraft Corporation Reports LR-2785-1** and **LR-2785-1,** "Effects of Aging at Elevated Temperatures upon the Properties of 24S-T Alcad and 24-RT Alclad," Aug. 1942.

(22) Tatman, M. E., and Miller, R. A.—Unpublished **CVAC Report No. SG-951,** "Aging of 24S Extrusions at 350 deg. F.," Oct. 1942.

(23) Tatman, M. E., and Jackson, K. R.—Unpublished **CVAC Report No. SG-952,** "Corrosion Tests on Aged 24S Aluminum Alloy," Oct. 1942.

(24) Unpublished **Douglas Aircraft Company Report SM-3612,** "Effects of Elevated Temperatures on Aluminum Alloys," Nov. 1942.

(25) Tatman, M. E., and Miller, R. A.—Unpublished **CVAC Report No. SG-962,** "Aging of Alclad 24S at Several Temperatures," Dec. 1942.

(26) Sangster, W. A., and Brown, O. E.—Unpublished **Vega Aircraft Corporation Report R-627,** "Effects of Accelerated Age Hardening on Properties of Extruded 24ST Aluminum Alloy." Dec. 1942.

(27) Tatman, M E., and Miller, R. A.—Unpublished **CVAC Report No. SG-995,** "Effect of Variations in the Stretching Operations Upon the Aging Characteristics of Alclad 24S Aluminum Alloy Aged at 355 deg. F.," Jan. 1943.

(28) Mozley, P. P.—"Elevated Temperature Aging of 24S Aluminum Alloy." Paper presented before the Institute of Aeronautical Sciences, Los Angeles, Calif., Jan. 1943.

(29) Nock, J. A., and Mears, R. B.—**Aluminum Research Laboratories Confidential Report 138-8-142,** "The Artificial Aging of 24S," Mar. 1943.

(30) Langhaar, H. L.—"Buckling of Aluminum Alloy Columns and Plates." Paper presented before the Annual Meeting of the Institute of Aeronautical Sciences, Los Angeles, Calif., Jan. 1943.

Cruise Control For Flying Efficiency

(*Continued from page* 211)

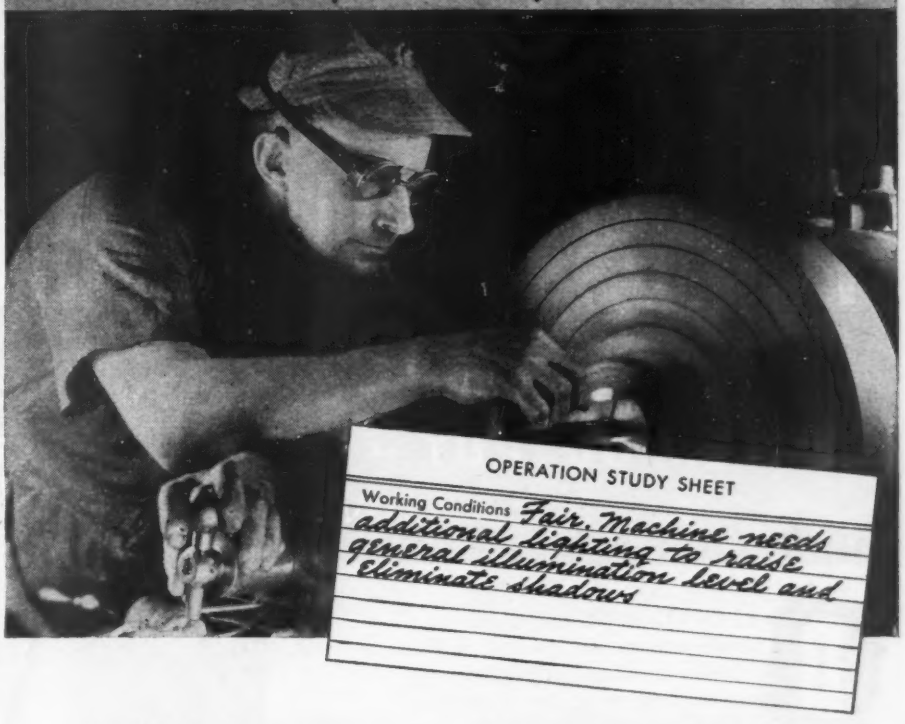
successfully operated for comparatively long periods of time at power above the specified limits. Such emergency operations, however, must be used only as absolutely necessary, because the design factors of the engine are largely determined by the specified operating limits, and any operation beyond these limits is definitely an unconservative operation.

The limits which are usually specified for engine operation are

1. Takeoff rating
2. Maximum except takeoff rating

(*Turn to page* 307)

RE-LIGHTING
the new manpower production *requirement*


OPERATION STUDY SHEET
Working Conditions Fair. Machine needs additional lighting to raise general illumination level and eliminate shadows

This man needs more light

The plant where this worker is employed—like most plants built before Pearl Harbor—was probably designed for peacetime production, with lighting equipment intended merely to supplement daylight. Hence, *its lighting system is inadequate for wartime night work*—and production falls off seriously on the "swing shifts."

Re-lighting for better illumination will correct this condition, make it easier for workers to see—thus increasing efficiency and production. Re-lighting costs little and is easy to arrange. A Silv-A-King lighting engineer, for instance, can tell you quickly how to re-locate lamps to eliminate glare and shadow...show you where it is necessary to increase lamp wattages or install additional equipment to insure uniform high lighting levels.

Silv-A-King fluorescent equipment, with reflectors of non-critical Silv-A-Tex, is available for prompt delivery to war plants. Silv-A-King equipment (fluorescent or incandescent), plus a Silv-A-King "engineered layout" make an unbeatable combination.

BRIGHT LIGHT REFLECTOR COMPANY, INC.
304 Morgan Avenue, Brooklyn 2, N. Y.

Send for new Folder 43-V describing Silv-A-King "Victory" Fluorescent Units.

FLUORESCENT
SILV-A-KING
INCANDESCENT

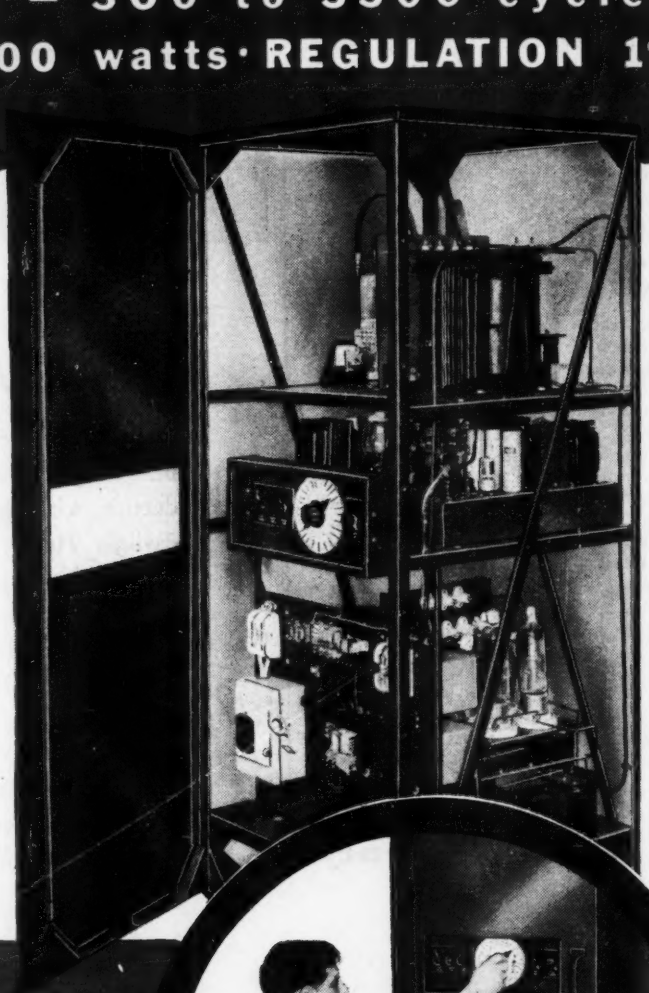
SILV-A-KING MAKES *Light* WORK FOR YOU

ANNOUNCING CML 1400

THE NEW, VERSATILE A-C POWER SOURCE

ELECTRONIC GENERATOR

FREQUENCY RANGE — 300 to 3500 cycles
POWER OUTPUT — 1400 watts · REGULATION 1%



DEVELOPED to fill the need for a versatile source of power, CML 1400 offers unusual advantages to engineers requiring test power at various loads through a wide frequency range.

CML 1400 is proving especially valuable where Government specifications call for complete system tests on the production line, through a wide range of power frequencies. In addition to factory and laboratory applications, maintenance and field service men are enthusiastic about the applications of CML 1400 to their work. Radio installations in aircraft can now be tested in the plane, or serviced in the repair shop without resorting to aircraft power supply ordinarily employed. Also test transformers and condensers.

Extremely simple in operation; completely foolproof controls. *DESCRIPTIVE BULLETINS AVAILABLE.*

COMMUNICATION MEASUREMENTS LABORATORY

Manufacturers of "ROTOBRIDGE" High Speed Cable and Circuit Tester

118 GREENWICH STREET NEW YORK

3. Maximum cruising power rating

The takeoff rating is specified as the maximum power to be used only during takeoff and as required in clearing obstructions. This power may also be used under emergency conditions for limited periods of time. The limited period of time for both takeoff and emergency operations is specified from one to five minutes duration, according to the individual engine concerned.

Maximum except takeoff rating is usually referred to as METO (pronounced metoe) power and is also referred to as normal rated power. This power is usually approximately 80 to 85 percent of the takeoff power and is specified as the maximum power at which the engine should be operated under emergency conditions for an indefinite length of time. These emergency conditions are usually caused by failure of the other engine, or engines, of the aircraft, although this power may also be used in high performance operation in climb or level flight. Ice formations on the exterior of the aircraft may also require the use of METO power.

Maximum cruising power ratings are established on the basis of conservative operation with the carburetor setting of the engine in lean position. This operation is assumed to be used for all of the flight except during takeoff, climb, and emergency conditions. Less power, of course, than this maximum cruising power can be and is quite often used.

Cruising power is usually specified according to percentages of METO power. A cruising power of 650 hp. for an engine whose METO power is 1,000 hp. would then represent a 65 percent cruising condition.

Table I gives the three engine ratings usually specified. The corresponding limits of related factors are given as information and guidance for the pilot. Ratings and limits as in Table I are for the Wright G102 engine.

When considering efficient long range cruising flight, the propulsive efficiency of the propellers is of utmost importance, since propulsive efficiency is the measure of how effectively power produced by the engines is being utilized. The constant speed propeller greatly simplifies this problem, since its propulsive efficiency is so nearly constant throughout most phases of operation.

Major variables to consider when discussing propulsive efficiency for any given aircraft are:

1. Revolutions per minute
2. Power output of the engine
3. Airspeed
4. Altitude

The variations of propulsive efficiencies are shown graphically in Figs. 3, 4 and 5.

HOW TO DO 4 HOURS WORK IN 3

BullDog Narrow Column Circuit Breaker Panels—a Quick Windup to Wiring Jobs

1-ONE MAN JOB

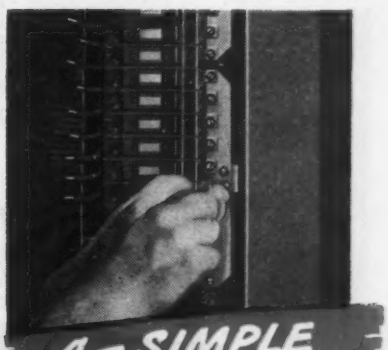
Light, compact pieces—no heavy or complicated parts that take more than one man's time to install.

2-ELBOW ROOM

Wireman not slowed by having to work in narrow "side" gutters as cables are pulled and connected.

3-CLEAR VIEW

Work is faster, surer, as branch circuit wires are led to retainers — no groping or guesswork.



4-SIMPLE

Major wiring job done in an empty cabinet — panel is set and connections made to main cables.

5-NO SOLDER

Branch wires are readily inserted and tightened in the Solderless Wire Grips.

Now is the time when plants *must* cut every corner, to save precious maintenance time. BullDog's Narrow Column Panels meet industry's wartime need for speed of installation and ease of upkeep. Write for complete bulletin No. 426, covering various types of BullDog time and money-saving equipment.

MANUFACTURERS OF Vacu-Break Safety Switches, SafToFuse Panelboards, Circuit Master Breakers, Switchboards, Bus Duct Systems—FOR LIGHT AND POWER.

BULLDOG
ELECTRIC PRODUCTS CO.
Detroit, Michigan

BullDog Electric Products of Canada, Ltd., Toronto, Ontario

Field Engineering Offices in All Principal Cities

In Fig. 3, propulsive efficiency is plotted versus rpm. for various values of brake horsepower. It is to be noted that large variations of propulsive efficiency can occur in constant speed propellers with improper use of engine rpm. It is also to be noted that for all horsepowers the propulsive efficiency is nearly constant when the correct operating rpm. (as circled) is used. Importance of rpm., as related to propeller efficiency, is readily apparent from Fig. 3.

Propulsive efficiency for any given power will also change with airspeed. This is illustrated in Fig. 4, in which the variation of propulsive efficiency for constant power and altitude is plotted versus rpm. with three curves, showing the propulsive efficiencies at three different airspeeds.

This chart is presented to establish the fact that with varying airspeed, propulsive efficiency does vary, but will not vary more than ± 1 percent for the usual range of engine rpm. However, large variations of efficiency may result from improper engine rpm.

Fig. 5, drawn for constant horsepower and constant indicated airspeed, illustrates the variation in propulsive efficiency with changes of altitude, other conditions being constant. Again it is to be noted that choice of engine rpm. can appreciably alter the propulsive efficiency.

In all three of the above mentioned curves, however, it is evident that propulsive efficiency can be held to within ± 1 percent throughout a wide range of engine rpm., airspeed, altitude, and power.

In addition to propulsive efficiency the other important item of cruising economy is specific fuel consumption. Engine rpm. is also of utmost importance in considering variations of this fuel consumption, which is defined as the pounds of fuel required per hour for each horsepower being produced by the engine. It is a direct measure of engine efficiency. The more efficient the engine is, the fewer pounds, or gallons, of fuel will be required per hour for any given horsepower.

Variation of specific fuel consumption with rpm. is plotted in Fig. 6 for various powers. It is thus evident that, for each power, there is an optimum rpm. from the standpoint of fuel consumption.

Thus rpm. influences both specific fuel consumption and propeller efficiency. It is self evident that for efficient long range operation, propulsive efficiency shall be a maximum and specific fuel consumption a minimum. Range of the airplane will vary directly as the propulsive efficiency and inversely as the specific fuel consumption, or, if η = propulsive efficiency, and c = specific fuel consumption, η/c should be a maximum for each operating condition of power, airspeed and altitude.

Fig. 7 illustrates now this can be accomplished. A separate graph like Fig. 7 should be prepared for representative altitudes. The rpm. for best η/c is shown for any condition of power and airspeed at the altitude for which the graph is drawn.

Brake mean effective pressure is a measure of the average pressure occurring in the cylinder, and thus it is a measure of the maximum pressure which occurs. The maximum pressure is a design criterion which must be respected in practical engine operation. When selecting rpm. for cruising and for best η/c, care must be taken that the maximum operating conditions of the engine are not exceeded. The maximum cruising brake mean effective pressure (BMEP) should never be exceeded during cruising, nor should maximum cruising power for the engines be exceeded.

Supercharger gear ratio also affects cruising economy. When engines have two supercharger gear ratios available, the high blower ratio will always require a higher specific fuel consumption

Makes Wheel Removal Quicker, Safer!

Mounted on 3 swivel casters and equipped with a simple screw-type jack arrangement for raising wheel to desired height, the Globe Wheel Dolly makes it easy to line up wheel with axle. Since the wheel rests on two *rollers* and is held in place by a chain, it can be readily rotated for indexing.

Jack arrangement of wheel cradle also permits one man, using the Globe Wheel Dolly, to pick up a wheel from a vertical position on the floor or ground without manual lifting or strain.

Dolly is capable of handling wheels up to 72" in diameter and weighing up to 1500 pounds. Weight of Dolly itself is 125 pounds.

For more information on the Globe Wheel Dolly or on the complete line of Globe Hydraulic Airplane Hoists, write or wire Globe Hoist Co., Mermaid La. at Queen St., Phila. 18, Pa.

GLOBE HOIST COMPANY
PHILADELPHIA, PA. DES MOINES, IOWA

then altitude, rpm., and brake horsepower are constant. A given power can be obtained, however, in high blower at a lower rpm. than in low blower, thus tending to improve the specific fuel consumption (reference Fig. 6) and effecting propulsive efficiency. It is then necessary to choose between high blower and low rpm. and low blower and higher rpm.

A good general rule has been found to cover this situation—"use low blower and higher rpm. as long as maximum allowable cruising rpm. in lean mixture is not exceeded. When maximum cruising rpm must be exceeded in low blower, high blower must be used." For more accurate supercharger procedures each type of engine should be individually studied.

When discussing fuel economy, it must be borne in mind that gallons per hour is really not a true measure of fuel consumption. Rather, pounds per hour is the correct measure. At first glance the two expressions may seem interchangeable since a gallon of gasoline is usually considered to weigh some definite amount (usually 6 lb. per gal.) in which case pounds per hour and gallons per hour would be directly proportionate. The weight of a gallon of gasoline, however, is influenced by temperature and chemical composition and will vary from refinery to refinery even for the same grade of gasoline.

Thus since the weight of a gallon of gasoline may vary considerably while the energy is directly proportional to weight, pounds per hour rather than gallons per hour is the best and most logical measure of fuel consumption. When a long range flight is planned the total number of pounds of gasoline rather than the number of gallons of gasoline should be specified by the pilot.

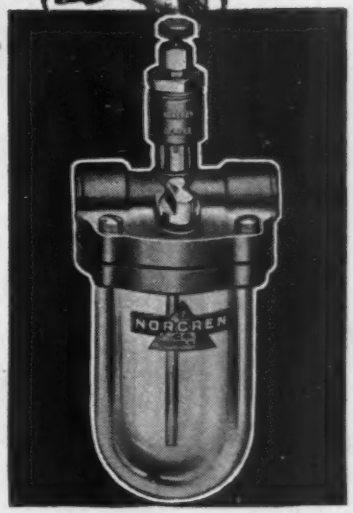
New Planes for Old

(*Continued from page* 215)

partment for recovering fabric covered components. The wing line has its own paint department, complete with air spray equipment and water screens. Fabric covered components, however, go to a central doping and painting department which handles all doping for new and repaired units alike.

The main body of the plane is hoisted by overhead crane into a "crib," where it is completely torn down. All that may be kept intact of the original plane is the rear fuselage section bearing the registration serial number, and even this section may have to be rebuilt, in which case the number is transferred to the new assembly. Radio equipment is sent to a special department devoted to this alone. All other parts removed in the crib are tagged according to condition

Striking Power



Striking power, brilliant as the flash of a killing eagle, is built into every air tool by its builders.

You can preserve that power indefinitely only by providing Norgren air-borne Lubrication —continuously! Investigate...

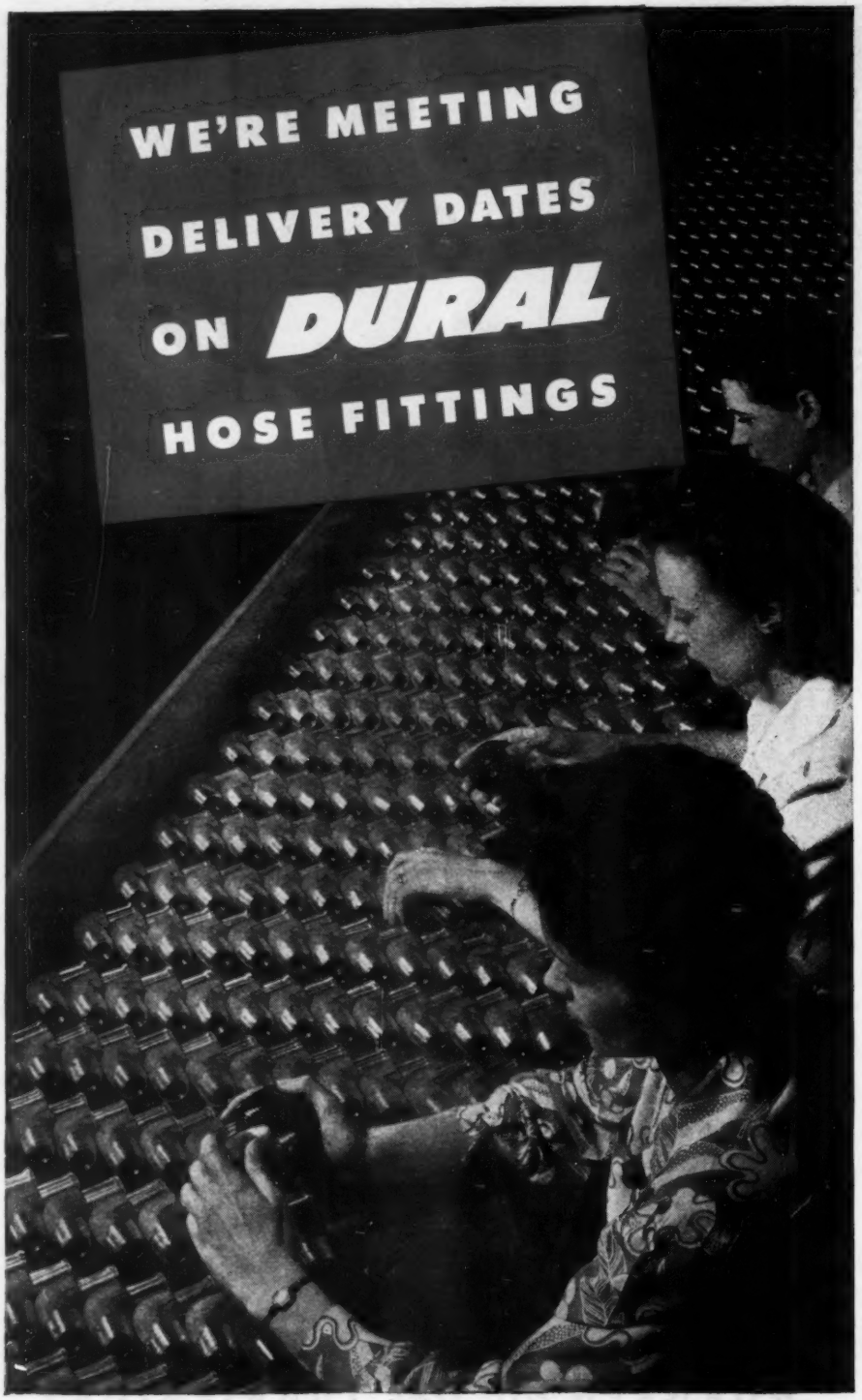
NORGREN *air line* LUBRICATORS

Install directly into air line. They inject exactly enough oil into the air stream to create an oil-air fog, lubricating every working part of the air tool.

Check wear in use. Stop destructive corrosion when idle. Automatic. Sight-feed. Save more than they cost in short order! Size and type for every purpose. Write to C. A. Norgren Co., 220 Santa Fe Drive, Denver, Colorado.

CATALOG 400

Norgren



Tooled for high speed, accurate production, we're turning out DURAL AN hose fittings at a rate that assures prompt and early handling of your order.

We are manufacturing DURAL bulkhead hose fittings for pressurized cabins —AN 846, 848 and 849, and the balance of the AN 840 to 847 series.

Blueprint specifications and uniform high quality are maintained by complete inspection after each operation, and a final inspection, which checks thread tolerances and all inside and outside dimensions. Hartwell hose fittings, except those made of barstock, are pressure tested by air, under kerosene, to 100 lbs. gauge pressure.

For emergency deliveries of DURAL AN hose fittings, wire our Los Angeles office, or the branch office nearest you.

HARTWELL AVIATION SUPPLY COMPANY

Aircraft Production Parts

3417 CRENSHAW BOULEVARD, LOS ANGELES, 16 · DALLAS, TEXAS · DETROIT, MICH. · KANSAS CITY, KAN.

and work required, then sent to their respective repair stations, which occupy the side of the building opposite the wing line. This side, also like the parent plant, is equipped with all necessary jigs and tools for repair and rebuilding of frames and parts.

Beginning with the original or rebuilt rear fuselage section, assembly begins at the next station beyond the tear-down crib. Previously repaired parts are brought together with the main frame, and the plane moves down the line, taking shape as it goes. In this way no aircraft has to wait on overhaul of its own particular parts, since all components of this trainer are interchangeable. Progress along the line moves with the rate of assembly of already repaired sections.

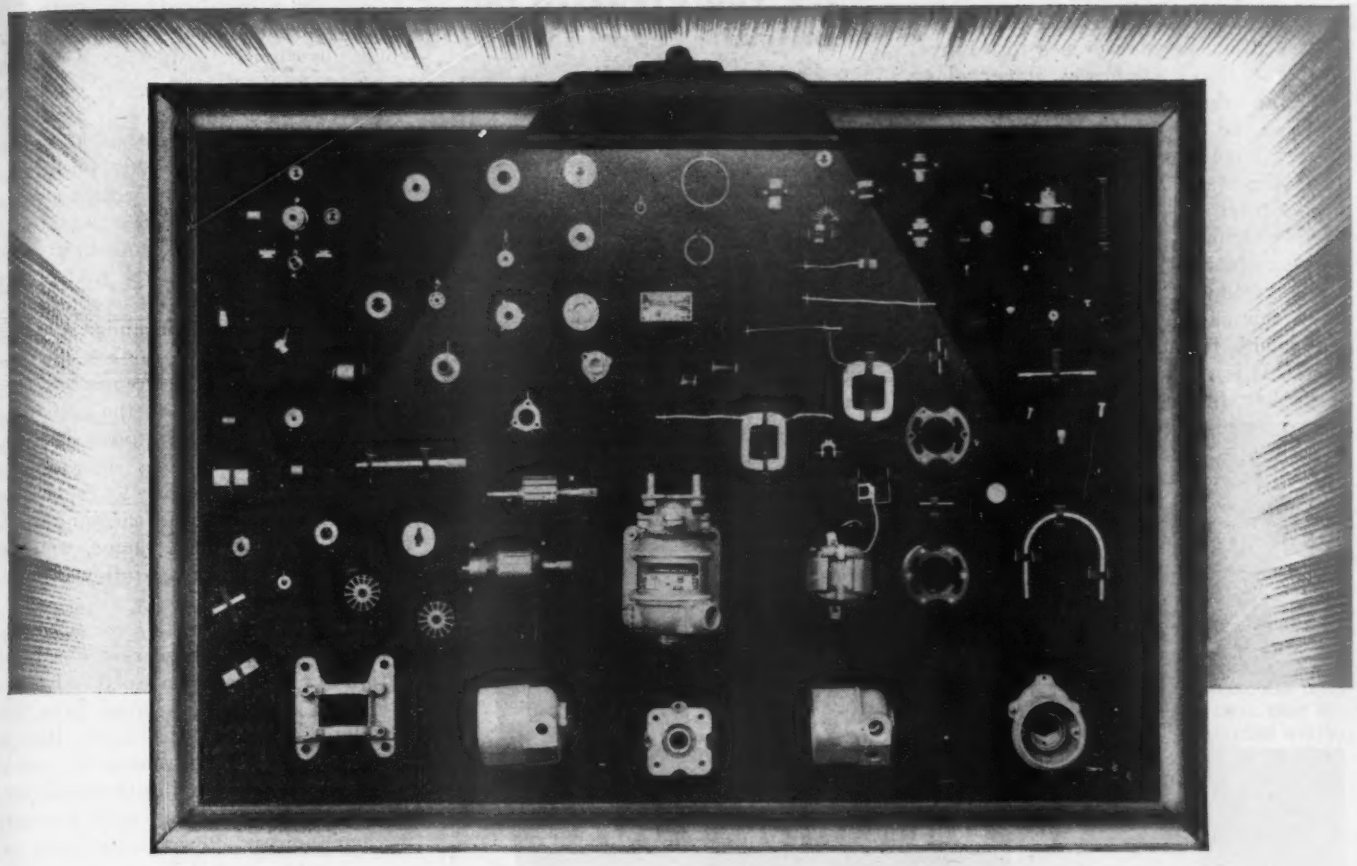
At further end of the wing line is the engine assembly section, where engines received from manufacturers and overhaul agents are assembled with accessories preparatory to installation on the airplane. At this point of the line the aircraft is nearly complete, awaiting only engine and instruments. After completion here, it passes under inspection both by the company and by the Air Inspection Division of the Canadian Government. Following this, if approved, it is sent outside the hangar for flight test.

A master control system is maintained to show visually in chart form the number and status of planes in for overhaul, as well as the parts of every type on hand. The first general control board tells number of craft received, their condition, parts to be repaired, parts under repair, those damaged beyond repair, stores on hand, and parts transferred to ship.

In addition, a chart is maintained showing, in graph form, progress and location in the shop of every plane by serial number. Thus any sort of tie-up is visible at a glance, with the reason stated in the margin—awaiting instruments, for example. Since this covers many individual units, another chart is necessary for an instrument breakdown to show just which unit or group is lacking. In this way, steps may be taken to remedy the shortage as soon as possible.

A case history and description of every plane overhauled is kept on file by serial number, so that in any question of what was missing from the aircraft when received, or what work was performed, the facts may be quickly referred to.

At the central office a record is kept of every part by serial number, with all work done on it and its transfer to any plane or planes. This bit of bookkeeping is mostly a wartime measure to cover cases of doubt in the multiplicity of orders from the RAF, RCAF, and AAF. In event of doubt over what happened



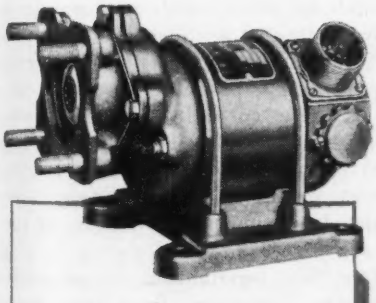
INSIDE STORY OF A *Motor...*

✱ Precise inter-relation of these many intricate parts in an aircraft motor is what we mean by *thorough engineering.*

Every part carefully designed . . . accurately made . . . to insure dependable performance under the extremely severe operating conditions of this application.

Building motors with rugged "physiques" yet compact in design and low in weight results from our many years' experience in the special application field.

This experience, covering all types of fractional horsepower motors, is available to your engineering department.



THOROUGH ENGINEERING is the basic factor behind the successful operation of this aircraft fuel pump motor and many other special application motors we have designed for all types of equipment.

THE BLACK & DECKER ELECTRIC CO.
KENT, OHIO

Black & Decker

FRACTIONAL HORSEPOWER SPECIAL APPLICATION **MOTORS**

to any particular order of parts, whether for shipping out or transfer to a plane on the premises, a reference to this record will show what was done, along with the original order sent in.

As in the rest of the Noorduyn plant, women have been extensively employed from the start. At present, 25 percent of the total personnel are women.

Thoroughness of the repair system and excellence of tooling and equipment make trainers and transports issuing from this shop's assembly line actually equivalent to new ships in every respect. It is part of the present philosophy that production figures are only part of the victory—that airplanes in the air are what count.

Are You Prepared for Contract Termination?

(*Continued from page* 126)

ment issues instructions to stop production on a contract until it is decided whether to cancel or continue production. Often, it is weeks and even months before that decision is reached. Mr. Peacock suggests that the government be obligated to issue definite instructions as to cancellation or continuance within 30 days after the stop-production order. Likewise the government should be prepared in all fairness to issue instructions within 30 days after an inventory is filed regarding the disposition of materials and parts produced or acquired for a cancelled contract and which become government property. At present contractors must store them for an indefinite time.

Should not a 30-day period also elapse between notice and the date when termination becomes effective? Such a period was customary in the last war and is specified in some contracts now in effect. Production cannot be shut off over night without laying off employees by the hundreds and thousands.

The subcontractor also has his fears regarding termination. As matters stand now, he must depend on the prime contractor for his pay. Suppose the prime contractor offers a big concession to the government in order to get a quick settlement and turn to peacetime operations. Will the subcontractor, who does not sit in on the negotiations, be the scapegoat?

An interdepartmental committee in Washington has been working on termination for several months. Confidential drafts of a uniform clause have been circulated from time to time. But the War and Navy Departments, which would be the principal government users of the clause have been only lukewarm in their interest. Perhaps they feel they are already protected in the various cancellation clauses written in their contracts.

The clause now under consideration provides that the contractor and the government agent will attempt to fix an amount representing fair compensation by agreement. However, if this step fails, after 90 days have lapsed from the time of the cancellation notice, the amount to be paid the contractor shall be determined by formula.

The contractor would have the option of two formulas: To pay for all costs incurred plus a predetermined percentage of these costs in lieu of profit, making no distinction between the completed or uncompleted portions of the contract, or an allocation between the completed and uncompleted parts of the contract.

While this termination clause draft applies to lump-sum fixed-price contracts, the committee also plans clauses for cost-plus-fixed-fee contracts. The present draft sets forth steps covering discontinuance of subcontracts on 15 days notice; provides that subcontractors should look to the prime contractor for payment, although the subcontractor may apply to the government for payment of his claim; and states that prime contractors must pay subcontractors after paying assignees. However, a committee member told the writer that a determination of subcontractors claims may need legislation.

He pointed out that with many firms holding hundreds or thousands of contracts, the proposed draft provided that

EVERY MAN COUNTS FOR MORE USING SKILSAW TOOLS!
Plane Production Soars WITH SKILSAW TOOLS on the job!
ARMY E NAVY
● Put SKILSAW TOOLS on your "bottleneck" jobs and watch them boost your plane production! That's what fast-working SKILSAW TOOLS are already doing in countless plants from coast to coast . . . speeding up tough "skin-drilling" . . . surfacing faster on wood, metals and compositions . . . sawing quicker in shipping rooms and on production lines.
SKILSAW TOOLS are lighter, more compact, more powerful. That's why they handle easier, do more jobs and do them faster. That's why SKILSAW TOOLS belong in your plant now. Ask your distributor for a convincing demonstration.
SKILSAW, INC., 5057 Elston Ave., Chicago
Sales and Service Branches in All Principal Cities
SKILSAWS—Saw faster, better on crating and uncrating jobs...cut lumber for freight car bracing quicker.
¼ IN. (Model 47) SKILDRILL—A handful of drilling power for extra speed on "skin-drilling" jobs.
SKILSAW BELT SANDERS—Speed up all sanding and surfacing jobs in pattern shops and assembly lines.
SKILSAW PORTABLE ELECTRIC TOOLS
★ MAKE AMERICA'S HANDS MORE PRODUCTIVE ★

settlement of one contract might be made in connection with other contracts. But, he admitted, there is no procedure specified as to how to do it. Here again, it develops, the committee itself recognizes the need for legislation by Congress to set things straight. And with legislation needed, it is none too early to get the ball rolling.

Contract termination problems were intricate enough when all war work was cancelled at one time in World War I. Everyone now expects that the war in Europe will be over long before the war in the Pacific. That means that contract termination will be even more complicated because of partial cancellations. Half the contracts of many aircraft companies may be cancelled while the others go on intact.

From industry has come a constructive suggestion to avoid the red tape and confusion that surrounds most all government activities on the home front these days. A commission should be named representing the government, industry, and the public to study the policies, procedures, and legislation desirable for an effective contract termination program.

Such a commission could decide whether agency rules or legislation is needed to meet the objectives of fair and reasonable contract termination. It could decide whether a single government agency should be set up to pay all claims, what remedies are necessary in the case of defective contracts, and what agency should immediately handle all the surplus inventories the government suddenly acquires.

Another matter for a policy making body is whether or not there can be over-all determination of claims. Consider, for example, the subcontractor way down the line who must segregate his materials, supplies, and overhead, and then render individual claims that must be passed up through several prime contractors for approval by different contracting officials.

Some means must be found for making advance payments to the contractor pending preparation and submission of his final claim—something that will take time to do. Then, too, arbitration should be explored to determine the extent it can be used in cases of disagreement.

Brig. Gen. John R. Delafield, chairman of the War Department contract adjustment board in the last war, advocates the immediate establishment of contract adjustment boards in the War and Navy Departments, with key personnel selected for the work and instructed how to carry it out when the need arises.

Others believe that an impartial tribunal, or "court of review," should be established to accelerate the settlement of all disputes. These parties have

These Little Drills Go a Long Way
Featherlight . . . snug right up in the palm . . . used as easily as pointing a finger . . . light enough for women workers . . . strong enough for any "roughneck" . . . that's the story on
UNITED STATES SPECIAL STREAMLINED AVIATION DRILLS
MODEL ARD
1/4"
weight only 3¾ lbs.
for use in cramped quarters
• • •
speeds from 750 to 5,000 r.p.m.
• • •
streamlined tip to tip
DRILLS . . . DRILL STANDS . . . VALVE SEAT GRINDERS . . . VALVE REFINISHING MACHINES AND SHOPS . . . PORTABLE SURFACERS . . . PORTABLE SANDERS . . . FLEXIBLE SHAFT MACHINES . . . LATHE GRINDERS . . . GRINDERS . . . BUFFERS . . . POLISHERS
Both drills are equipped with 3-jaw screw chuck; 7 ft. 3-wire rubber covered cable, indestructible rubber attachment plug.
MODEL ARS
1/4"
weight only 4¾ lbs.
Reasonably prompt deliveries.
THE GOOD MECHANIC'S CHOICE
THE UNITED STATES ELECTRICAL TOOL CO.
CINCINNATI, OHIO, U.S.A.

The
POWER
to
RAISE HELL!
It is a National determination that is now channelled as a force to destroy the Axis! For "raining" tons of bombs on the enemy American engine builders are designing and developing prodigious power, both in individual aircraft engines and collectively, to "raise" to stratospheric heights the "hell" that the Axis itself has loosed against free peoples. Aircraft engine designers know that they can rely on U. S. Super-Positive Piston Rings to control the whole power potential of America's super fuels, in its flow to the prop.
For Ring Conditions
Favoring Peak Performance...
Use U. S. Super-Positives
U. S. HAMMERED PISTON RING CO., INC.
STIRLING, NEW JERSEY, U. S. A.

a pronounced aversion to termination clauses where one party to the agreement is judge, jury, and prosecutor.

Industry is now more convinced than ever that war production will taper off very materially before all fighting ends. It feels that not a moment should be lost by the Administration or by Congress in establishing efficient machinery for coping with terminated contracts.

Aircraft's leaders know that the success of their postwar planning depends upon the orderly and quick settlement of their war claims. That's why "when in war prepare for termination" is a criterion which makes sense to them.

Cutting Costs on Perforating Dies

(*Continued from page* 167)

vents hot Cerromatrix poured into openings around the punches from flowing onto die pad.

It is important that each of the punches and dies rests against one of the die shoes. To insure this condition, rear face of the punch pad and projecting ends of the dies at rear face of punch pad are subjected to surface grinding operations. Top face of the die pad may also be ground to remove any excess Cerromatrix. Fig. 9 shows top faces of completed die sections.

A relatively simple die was used to illustrate the manufacturing procedure. It will be understood that various shapes and sizes of punches may be used as shown in Fig. 10. Moreover, extremely large dies may be very economically produced in accordance with this process.

It will be observed that the dies project beyond bottom face of the die pad. Projecting portions of dies are provided with openings, as shown in Figs. 1 and 2, for slug ejection. This feature eliminates need for steel parallels or the like to provide clearance for slugs between die pad and shoe.

The punches and dies, which are made from drill rod, may be easily removed from pads by heating the Cerromatrix. The amount of heat required to melt Cerromatrix does not injure Masonite, punches, or dies. Whenever a particular die assembly is obsolete, the Cerromatrix, punches, dies, and bushings may be reclaimed for their further use.

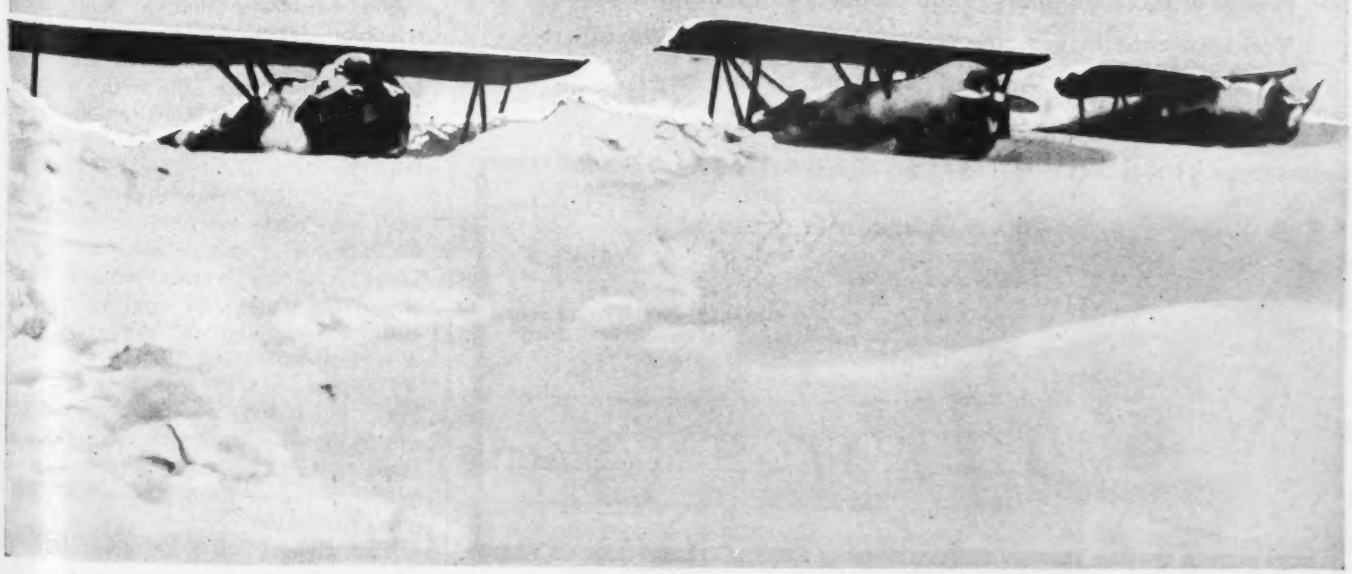
Where close spacing of holes in a part is required, a relatively large opening may be formed in the pad to receive closely positioned punches or dies. Under exceptional conditions the shank portions of punches and dies may be reduced by a grinding operator to provide extremely close relationship.

While low cost of the die more than justified its use in mass production ap-

LESSON FOR AUGUST

Out on the Arizona desert where the thermometer is boiling up around 120° this summer, hundreds of Kinner engines are earning a new record for dependability in their daily primary training grind. And when another sub-zero winter blows over Canada this fall, other Kinners will help to keep the British training program going, too. Few owners can ever subject their engines to such sustained torture. But it is satisfying for Kinner owners to know that in August they won't have to worry about their Kinners next January. Kinner Motors, Inc., Glendale, California.

KINNER MOTORS INC. KINNER GLENDALE CALIFORNIA U.S.A.



plications, it is not advisable to employ the new die for making less than a hundred parts. In determining the number of parts to be punched, the feasibility of punching both right and left hand parts should be considered. By punching blanks before forming parts, it has been found that frequently the same die may be used to punch both right and left hand parts, also mating parts.

Advantages of the die as compared to drilling holes in sheet stock are readily apparent. In using the die, all holes, regardless of pattern, size, or shape may be quickly formed in one operation. Holes are accurately located and do not have to be burred. Moreover, stainless steel, which is difficult to drill, may be readily punched by the new die.

The die not only produces results which are equal to the action of a steel die but may also be employed in numerous operations where cost and time required to make a steel die would prohibit its use. A Masonite die is substantially lighter than a steel die of equal size, thereby requiring less effort and time to set up. Another important advantage, especially under present conditions, is that it can be quickly and accurately made by semi-skilled labor.

While the new process was primarily developed for making perforating dies, it has been found that blanking and other types frequently can be produced economically by employing Masonite pads, with Cerromatrix to hold the die elements in position.

When Is a Pilot Legally Liable?

(*Continued from page* 231)

or with only one gallon of gasoline in the tank is not safe . . . No doubt expert witnesses should be allowed to testify as to the probable consequences of flying with a loose magneto or a small supply of gasoline, *but testimony that such flying was not safe went beyond the scope of expert testimony* and covered the ultimate fact which the jury were required to determine."

Ordinary Care Required

It is important to know that a uniform law has been passed in many states (Delaware, Idaho, Indiana, Wisconsin, Maryland, Michigan, Nevada, North Dakota, South Dakota, Tennessee, Utah, Vermont, also Hawaii) as follows: "The liability of the owner of one aircraft, to the owner of another aircraft, or to aeronauts or passengers on either aircraft, for damage caused by collision on land or in the air shall be determined by the rules of law applicable to torts on land."

In other words, the courts when determining the liability for airplane collisions shall abide by the previously decided law laid down by the higher courts with respect to automobile accidents.

In states where such a law has not been passed, the common-law rule is that every person shall use *ordinary care* not to injure another. This law is applicable to all classifications of airplane injury cases.

For instance, in Greunke vs. North American Airways Co. (230 N. W. 618) it was disclosed that a man named Greunke ran his plane out onto a runway one afternoon, made a flight, and subsequently came down in a "dead stick" landing. As soon as his plane stopped on the runway, he got out and tried to start the engine so as to remove his plane from the runway, but before he could get the engine started, an employe of the defendant company landed on the runway just behind Greunke's plane and collided with it, causing considerable damage. Both were licensed pilots.

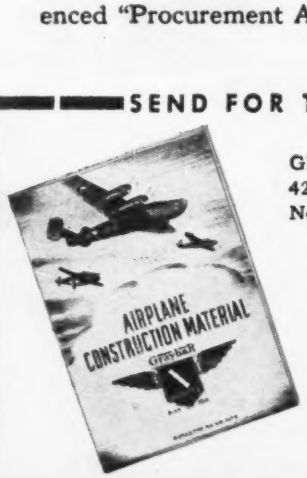
Greunke sued the company for damages. Since there were no state statutes governing the operation and management of the airplanes at the time and place of the accident, the common law was applicable.

The airport pilot testified that be-

SAVE TIME when you buy Electrical Plane Materials

A single order to GRAYBAR can cover your electrical needs from twenty or more suppliers of the products you build into planes. You save time in ordering, expediting, accounting. An experienced "Procurement Advisor" is at your service locally.

SEND FOR THIS 120-PAGE CATALOG



8-A

GRAYBAR ELECTRIC COMPANY
420 Lexington Avenue
New York 17, N. Y.

Send me your Catalog GB-5018 and details of your specialized electrical parts service for the aircraft industry.

Name.....

Company.....

Street.....

City.....*State*.....

cause of the color of Greunke's plane, and the reflection of the light from the landing field, it was impossible to see the airplane on the runway, and that he did not see it in time to avoid the accident. The company contended that it was the duty of Greunke to remove his airplane from the runway promptly upon landing, and that, in case his engine was stalled, he should have taken his plane by the tail and pulled it off the runway.

The judge of the lower court instructed the jury that it is the duty of every pilot operating an airplane to exercise the *highest degree* of care that men of reasonable foresight ordinarily exercise in the practical conduct and operation of an airplane. In view of this instruction the jury held the company liable in damages to Greunke. However, the higher court reversed this verdict, pointing out that the judge's instruction had been improper. Said the higher court:

"It was *not* the duty of the company pilot 'to use the highest degree of care that men of reasonable vigilance and foresight ordinarily exercise in the practical conduct and operation of an airplane in making a landing on a runway in an airport under the same or similar circumstances,' but it was his duty to use *ordinary care,* as that term has been so often defined to mean . . . ."

Law of Independent Contractor

Frequently this question is represented: When an owner rents an airplane, is the owner or the hirer liable in damages for injuries effected by the operator?

If the owner hires out an airplane and the pilot is paid by day or week either by the owner or the renter *and the renter directs and controls the pilot,* the owner of the airplane is *not* liable for the injuries received by the flyer nor negligently effected by him.

If, however, the owner of the airplane furnishes the pilot and agrees to perform certain services, and the renter does *not* have the right to exercise absolute control over the pilot, the owner of the airplane is responsible for the injurious acts of the pilot. This law is applicable irrespective of other details or testimony.

For illustration, there is the leading case of Gale vs. State Industrial (294 Pac. 391) where pilot was killed in an airplane accident. During the trial, which involved damages, evidence was introduced showing that the plane's designer had constructed the ship believing it capable of establishing some new records. He was informed by an official of an oil company that if the airplane met with approval, the company would give the financial assistance required. Later a written agreement to this effect was entered into between the

Extended Range!
Permoflux Dynamic Headphones Mean Extra Striking Power!
Carrier planes cannot safely extend operations beyond their effective communication range. A few extra miles may sometimes mean the accomplishment of otherwise impossible objectives. The high sensitivity and wide, uniform frequency response of Permaflux Dynamic Headphones at all altitudes, provide improved intelligibility under adverse noise level conditions — assure reception of vital messages at maximum distance from home base.
BUY WAR BONDS FOR VICTORY!
TRADE MARK
PERM-O-FLUX
CORPORATION
4916-22 W. Grand Ave., Chicago, Ill.
PIONEER MANUFACTURERS OF PERMANENT MAGNET DYNAMIC TRANSDUCERS

This is the first of a series of statements by aviation's leaders on THE SHAPE OF FLYING TO COME

"Air Yachts and Flying Motorcycles"

says Harry Woodhead, President of Consolidated-Vultee Aircraft Corp.

"I WOULD LIKE TO SEE an air force composed of thousands of all types of military aircraft of latest design—properly maintained, kept up to date by an extensive development program and able to get to any part of the globe within 24 to 36 hours to throttle, at birth, dreams of conquest by future Hitlers and Mussolinis.

"I would like to see started immediately after peace comes an intensive program of development of domestic and transoceanic airlines carrying both passengers and cargo—and a more liberal policy to provide sound, service-improving competition on international routes.

"And I would like to see a sound plan to encourage private ownership of aircraft ranging from air yachts to flying motorcycles, resulting in the postwar maintenance of a reservoir of pilots who can be called upon in emergency. The bulk of such craft would be low in price with reasonable servicing facilities available. The government should furnish free use of airways, airports, landing strips and, through further development of electronics, provide safe means of blind flying, take-off, and landing. Simplified design of aircraft, making mechanical care easy, coupled with the above, should do for private aircraft what good roads and service stations did for the automobile."

Out of the broad thinking of men like Harry Woodhead and others who are charting the skies for our future, has come an aviation industry greater than any of our dreams—but an industry whose shape is yet to be determined.

In molding that shape, aviation has a great group of silent partners: the TIME-reading men and women on whom aviation focuses most of its advertising—the people who have the executive jobs, the income, and the habit-of-accepting-progress that will help fill aviation's transport and cargo planes, help fly aviation's family planes through the skies of the postwar world.

Believing that the ideas of aviation's leaders are always of interest to the aviation industry, TIME here begins to give them wider circulation in the name of

AVIATION'S SILENT PARTNERS

TIME

THE READERS OF TIME

oil company and the designer.

However, objection was made by the oil company official to a certain pilot whom the designer had employed, and later the designer hired another pilot, telling the new man that the oil company would pay his wages. This pilot interviewed the oil company official and arrangements on wages were completed. Subsequently the airplane was hauled to a field by the oil company's employees and the company's name was printed on both sides of the airplane in large letters.

Several test flights were made, and thereafter two attempts were made to break the altitude record. An attempt was then made by the pilot to break a speed record over a course laid out under the supervision of the oil company official. It was while attempting this flight that the accident occurred which resulted in the wreck of the airplane and the death of the pilot.

The higher court held the oil company not liable for payment of damages to the pilot's dependents on the grounds that the pilot was not a legal employee of the oil company.

This is an important decision in view of the testimony that the oil company had its name printed on the airplane and its official had approved selection of the pilot and agreed to pay his wages. Moreover, the test flight course was laid out by the oil company official. However, the testimony did *not* prove that the oil company official controlled the acts of the pilot nor directed him how to perform the test flight.

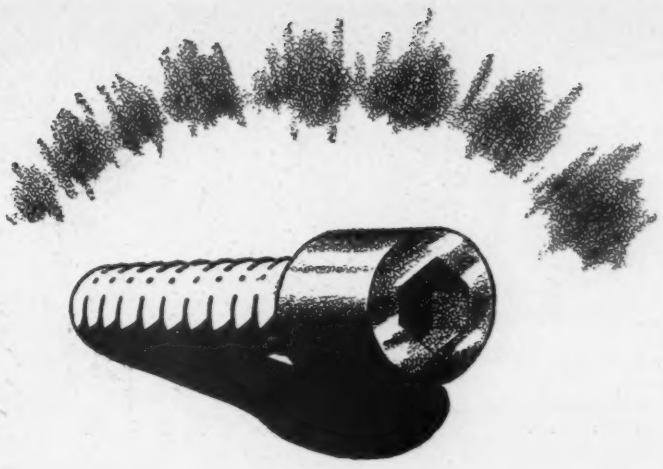
Therefore, the pilot was held to be a legal "independent contractor" rather than a legal agent or representative of the oil company. This fact relieved the oil company from liability for death of the pilot and also for injuries that might have been caused by the pilot to persons or property.

British Bomber-Transport Conversion

(*Continued from page* 227)

used for carrying freight and passengers. Modifications have been difficult because the work has had to be done quickly, and especially because of shortages of materials and labor. Austerity has been the keynote of all British air services on wartime routes, where every ounce of payload has been important. Bombers can be made to carry a certain amount of freight, but for passenger-carrying comfort they cannot measure up to prewar commercial standards. For urgent services, of course, the comfort factor has been of minor importance.

Modifications made to military types have not been of standard form because



READY FOR ACTION!

Secure Chemically and Metallurgically Clean Basis Metals by Using Compounds Developed for Aviation Problems!

METALEX for TUMBLING BARRELS

METALEX compounds are individually developed for faster cleaning action in tumbling barrels and rotary washers, are easier to use and are particularly economical. Let us show you the METALEX compound developed for your products or write for free Data Sheets.

Let Us Mail You These
INFORMATIVE FOLDERS

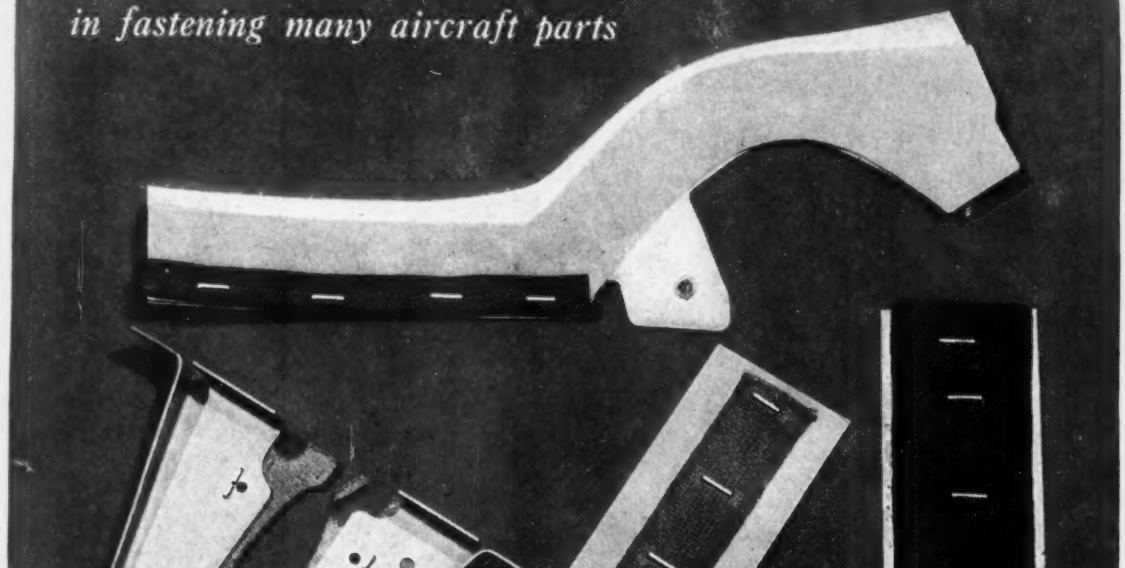
"The Inside Story About ANODEX Reverse Current Process" Read how to secure chemically and metallurgically clean ferrous metals in less time, at lower costs with this popular, new, electro-cleaning process and the high-speed ANODEX compounds.

"15 Ways To Improve Your Product with METEX Compounds. Learn why so many others are using METEX compounds for cleaning aluminum, aluminum alloys, copper and brass. Determine the fastest, most positive compound for cleaning your product.

MAC DERMID
INCORPORATED
WATERBURY, CONNECTICUT
SALES AND SERVICE FROM COAST TO COAST
Los Angeles, St. Louis, Toronto, Canada, Chicago, Newark, New York, Cleveland, Detroit, Philadelphia

VALUABLE TIME SAVED—AT LEAST 50%

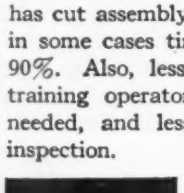
in fastening many aircraft parts



Top: two sheets of aluminum, one layer of felt
Left: aluminum and leather
Center: aluminum and webbing
Right: aluminum and thick layer of felt
Bottom: two sheets of aluminum, one layer of felt

by BOSTITCHING

On many applications, the use of Bostitch Aircraft-Type Metal Stitchers has cut assembly time at least 50% — in some cases time savings may reach 90%. Also, less time is required for training operators, less floor space is needed, and less time is needed for inspection.



Unretouched photograph of cross-section of Bostitched aluminum sheets — actual size.

Metal parts and parts made of other non-brittle materials are being successfully fastened today by wire formed into staples, punched through the work and clinched flat on the under side. No preparation (such as drilling the hole) is required, the perforation is clean, the fit close, and the clinch provides full bearing against the material. Such materials as aluminum can be fastened without danger of fracture or warping and the stitch can be accurately and quickly positioned.

The Bostitch Aircraft-Type Metal Stitcher is a development of the highly-successful Bostitch Metal Stitcher, widely used in the automobile and other steel fabrication industries during the past six years. This, in turn, is a natural development of a line of wire stitchers comprising some eighty-odd models and backed by over forty years of stitcher manufacturing. In addition to these, Bostitch is noted for its complete line of stapling pliers, self-feeding hammers, tackers, and heavy-duty hand-, foot-, and motor-operated stapling machines. This line is broad enough to provide the most efficient stapling equipment for nearly every fastening job. Ask about the nearest Bostitch field service office.

BOSTITCH (Boston Wire Stitcher Co.), 54 Blackmore St., East Greenwich, R. I.
(Bostitch-Canada, Ltd., Montreal)

BOSTITCH
fastens it better AND FASTER *with wire*
ALL TYPES OF STAPLES APPLIED BY MACHINES
ALL TYPES OF MACHINES FOR APPLYING STAPLES

of the varying duties the aircraft have been required to perform. Few structural changes have been made, but every scrap of unnecessary equipment has been stripped from all types. On the *Hudsons,* for instance, removal of the bomb door mechanism meant a saving of some 65 lb.

All types, except the *Whitleys,* carry some passengers and have been fitted with special lightweight chairs. Some of the craft have lightweight adjustable seats of the type formerly used by Imperial Airways on its airliners. Some have had light flooring put in to cover the bomb bays and have then been fitted with passenger seats. Extra radio equipment, such as is carried on all the aircraft of British Overseas Airways, has been fitted in all the converted bombers used by the corporation, along with the rubber passenger dinghies which are standard on the civil machines.

The Consolidated *Liberators,* used by the Return Ferry Service which carries ferry pilots from Britain to Canada, are mainly the early versions—the *Liberator* I or LB-30 type. These have had bunks fitted in the bomb bays and benches set up in the rear of the fuselage. The bunks, like those in submarines, are so closely spaced as to leave little head-room for the passengers, one of whom remarked after a 17 hr. flight, "Pity the poor sardine."

Besides employment over the Atlantic, *Liberators* are also used on services to West Africa, and one was specially fitted up for Prime Minister Churchill's flights to the Middle East, Moscow, and North Africa.

Most of the *Liberators* have had their noses blacked in, with this compartment then adapted for stowing freight and mails. A few have had their fuselages or cabins made a little more comfortable by a panelling of three-ply. These ships are fitted with eight or nine adjustable chairs, but the whole effect is far from luxurious.

Gun blisters on the *Catalinas* have not been removed. The planes carry much freight plus six or seven passengers on long routes.

Armstrong Whitworth *Whitley V's* are used for freight work only. Here, noses and tails have been faired-in and given smallish, square windows. Extra fuel tanks are carried in the bomb bays and behind the doors, and room has been made in the fuselages for the stowing of freight. Lockers have likewise been built for stowage purposes. *Liberators* and *Hudsons,* especially, are provided with oxygen equipment for both crew and passengers.

Apart from some of the *Liberators,* which were modified in Canada for transport work, all the work of converting the bombers for civil transport work has been done by BOAC in its own workshops, where any new parts needed have also been built.

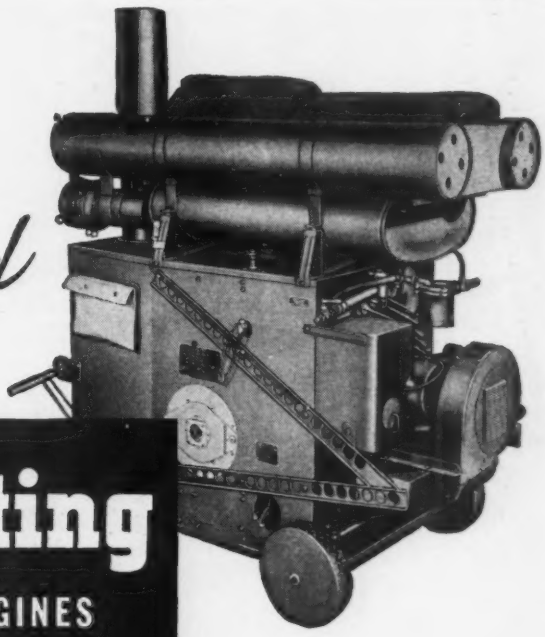
The only bomber used for transport after being considered obsolete for military service is the *Whitley,* which is now used mainly for training purposes with the RAF. All the rest—the *Wellingtons, Hudsons, Liberators,* and *Catalinas*—are on active service with the Coastal Command of the RAF. The *Wellingtons* are also still in service with the Bomber Command for raiding Germany and mine-laying.

Work was started last year on the first new British transport since the war began—the Avro *York*—a type being developed from the Avro *Lancaster* bomber. Plans are also now to be made for the organized conversion of other bomber types for transport use.

Pre-Flight Toughens 'Em

(*Continued from page* 125)

academic facts that the cadet must possess before he endeavors to master the instruments, engines, propellers, avigation, and the other fundamentals of flight, the Training Command conducts "colleges" on the ground from



Designed for

Preheating

AIRCRAFT ENGINES
IN SEVERE COLD WEATHER

Now is the time to consider the cold weather difficulties which aircraft manufacturers, airline and airport operating personnel will encounter this winter!

The Herman Nelson Portable Self-Powered Heaters, originally developed for our armed forces, were successfully used last winter at Army and Navy Bases everywhere.

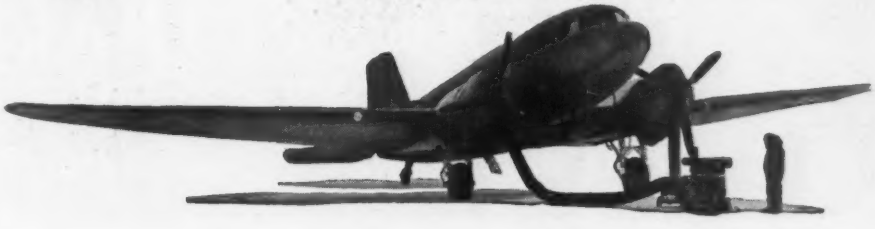
These portable, light-weight, sturdy, self-powered ground heaters are now available to commercial users who are engaged in essential war activities. Write today for complete information and please include a statement of your particular heating problem.

herman nelson moline illinois

THE HERMAN NELSON CORPORATION

Manufacturers of Quality Heating, Ventilating and Air Conditioning Products

MOLINE, ILLINOIS



which students must graduate before climbing for the first time into a cockpit.

Pre-flight school, more than any of the other phases of air training, most resembles the peacetime educational institution. It imparts "book learning" in the real sense. It raises the level of student understanding to a common peak. And, in addition, it is here that the cadet becomes a soldier, obtaining acquaintance with the stern lessons of discipline, order, and smartness of appearance and action.

In the finest tradition of the service, the new cadet acquires a respect for authority and efficiency.

Pre-flight school presents a nine-weeks' course. But, instead of adding nine weeks to the total period required for the transformation of a plain American youngster into a combat pilot, it clips considerable time from the flight training aggregate. With confidence in himself, and equipped to absorb quickly future lessons which must be associated with those learned in pre-flight school, the cadet progresses relatively smoothly up the ladder toward his wings. The instructor at elementary, basic, and advanced school is enabled, as a result, to be less circuitous in his methods, less involved in his explanations, because the cadet already knows something about the problem at hand.

In addition, cadet eliminations are reduced. And, applying ground discipline acquired at "foot soldier" drill to that air discipline upon which combat successes depend, he is a safer, saner potential pilot who keeps his eyes and ears open.

A third highly important job performed at pre-flight is that of conditioning cadets physically for the gruelling demands of the modern flying mission. For instance, a pilot must keep his head moving constantly, in order to be on the alert for enemy craft and for friendly planes that may be approaching him at a dangerous angle. So at pre-flight, the future pilot does many hours of neck exercises, as well as others calculated to increase his coordination and strengthen the muscles he will need in his future air crew job.

Pre-flight is the last hurdle the cadet must clear before getting to the real business at hand—that of sprouting his wings. When he reports for his nine weeks, he may already have received a general "arts and sciences" course at an accredited civilian-operated college under a recently-inaugurated Flying Training Command plan. He also has spent from three to five weeks at a classification center where he was subjected to a wide variety of interviews and tests designed to determine the air job for which he is best suited by aptitude and background. It is at the classification center that he is designated for schooling as pilot, bombardier, or navigator.

Although he may have been a Harvard man or a boy from the farm, a master sergeant in the Army or a private in the rear rank—he's just another green "gadget" (cadet) when he arrives at pre-flight. He has his uniforms and his GI haircut, and regardless of his social, financial, or military heritage, he looks very much like the next "mister" on his right or left when he lines up by his trim barracks to be scanned by eagle-eyed upperclassmen.

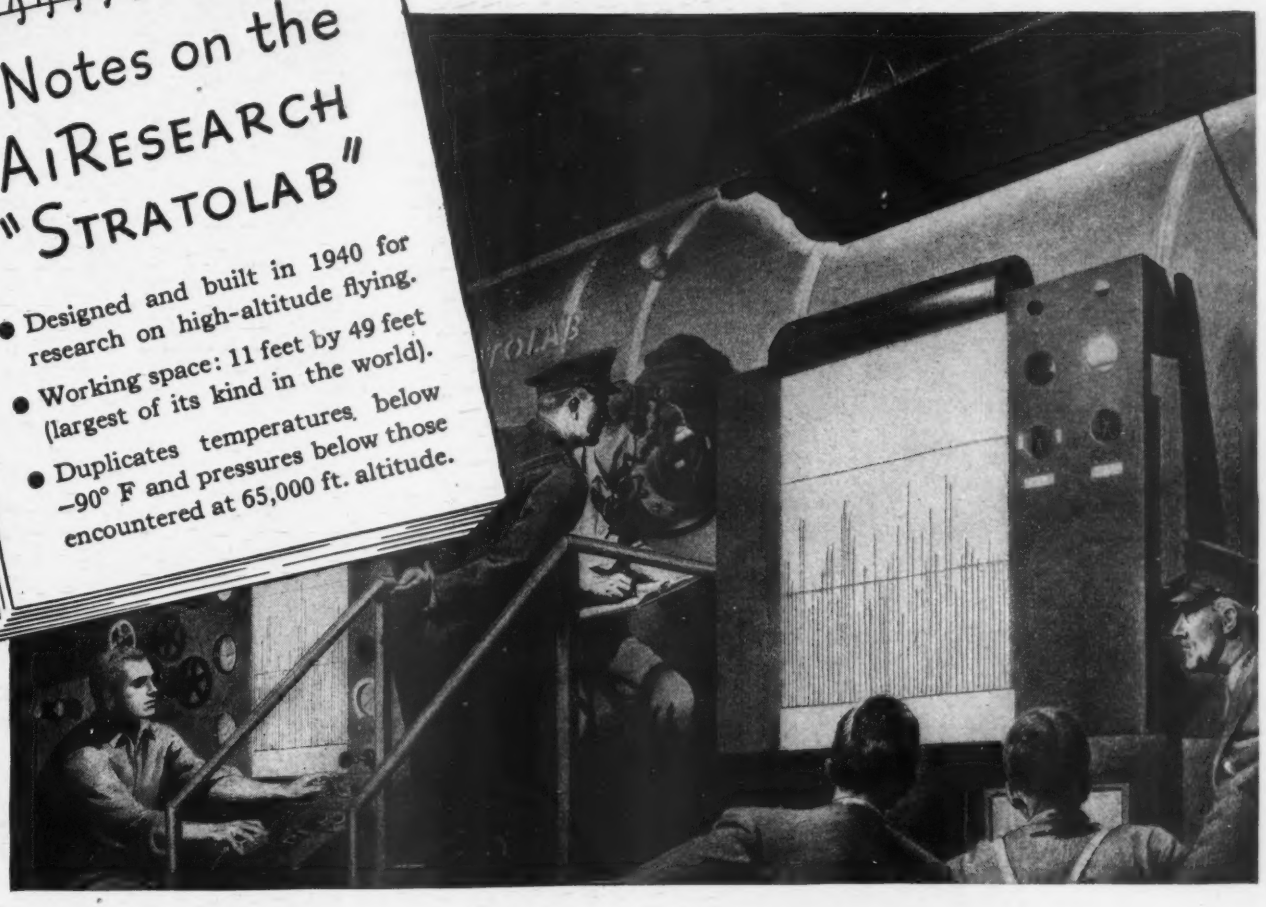
Up before dawn, he begins that nonstop motion that will keep him on the run "for the duration". He puts military folds at the corners of his bed sheets and blankets; he sweeps, dusts, and polishes; he checks and re-checks the quality of his shave and appearance before dashing out the door to join his mates at reveille.

The future Axis-blaster eats wholesome food three times a day—and as his schedule accelerates in the classroom and on the drill and athletics field, the tempo of his life may be gaged by the growing amounts of potatoes, steak, and vegetables he consumes. He gets lean, hard-

HANGING AN
S.O.S. IN THE SKY
These parachute suspended signals have been the means of rescue for many a stranded flier.
Pistol-expelled, these flares were developed by International for commercial aviation and marine use long before this war began. Today they're standard equipment on almost every plane in our air force and our allies'. Small and compact, they pierce the distance with a red flare . . . a signal of distress in any language.
★ For continuing excellence in production of war material, we are proud to fly the ARMY-NAVY "E" Flag with one STAR added.
ARMY E NAVY
INTERNATIONAL
FLARE – SIGNAL DIV.
of THE KILGORE MFG. CO. Tipp City, Ohio

Notes on the AiResearch "Stratolab"

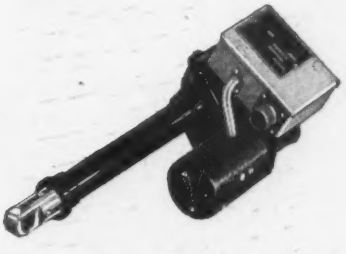
- Designed and built in 1940 for research on high-altitude flying.
- Working space: 11 feet by 49 feet (largest of its kind in the world).
- Duplicates temperatures below –90° F and pressures below those encountered at 65,000 ft. altitude.



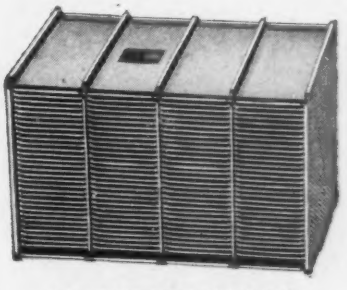
FROM this "Stratolab" have come important aviation discoveries: A newer knowledge of the reaction of metals to temperature variations... methods for controlling temperatures and air pressures to improve engine performance and crew comfort. Plus automatic control equipment that makes American airplanes superior in whatever climates and at whatever altitudes they fly.

Here, AiResearch engineers have perfected such developments as—

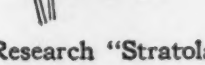
A NEW-TYPE OIL COOLER THAT *CAN'T* CONGEAL



A SYSTEM OF *AUTOMATIC* EXIT FLAP CONTROL



AN *ALTITUDE-RAISING,* LIGHTWEIGHT INTERCOOLER



TODAY the AiResearch "Stratolab" is used largely for military purposes. After the war, it and AiResearch's air control engineering experience will be available to all aircraft designers and manufacturers. Inquiries are invited now.

AiResearch
MANUFACTURING COMPANY
LOS ANGELES • PHOENIX
DIVISION OF THE GARRETT CORPORATION

"Where Controlled Air Does the Job" • Automatic Exit Flap Control Systems • Engine Oil Cooling Systems • Engine Air Intercooling Systems • Exhaust Heat Exchangers • Supercharger Aftercooling Systems • Engine Coolant Systems

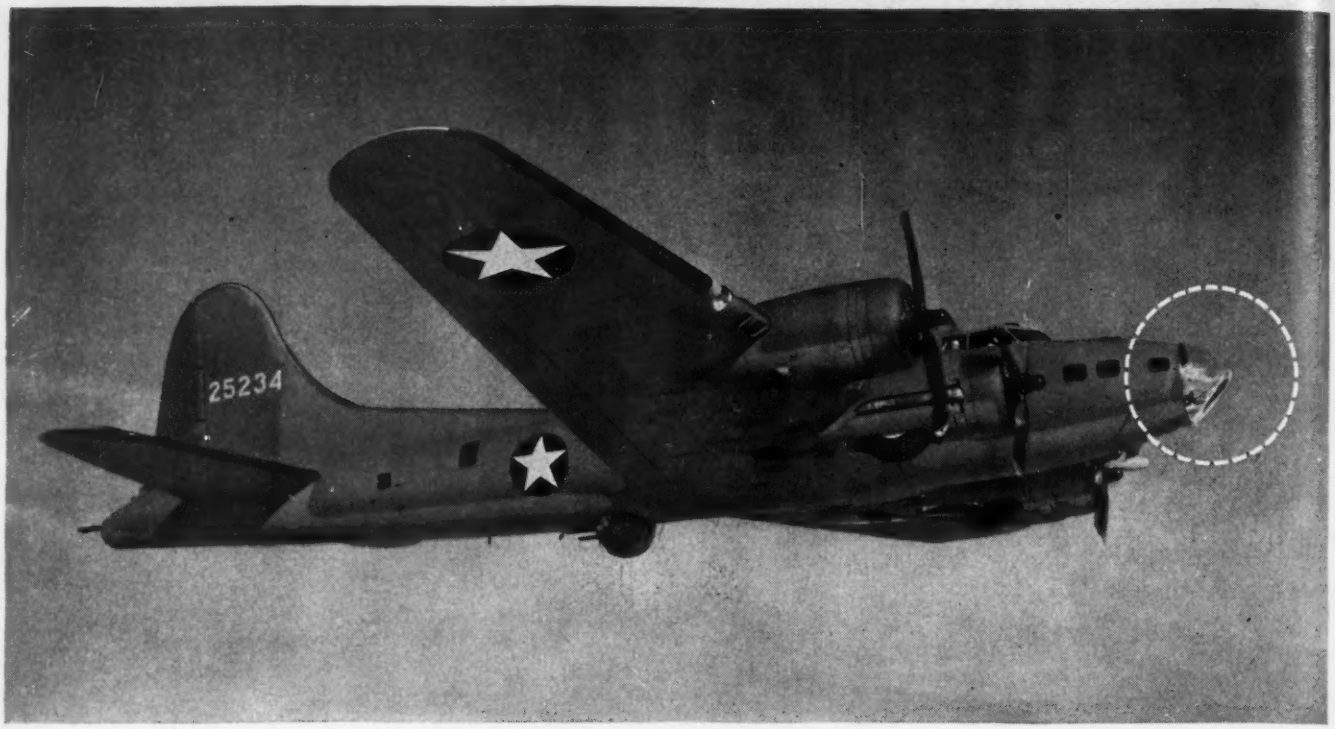
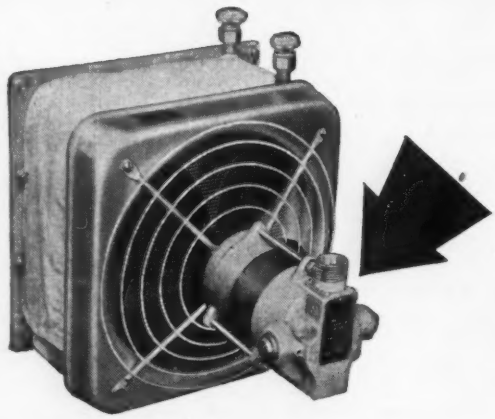


Photo courtesy Boeing Aircraft Company

This Bomber needs its "greenhouse"—

its small electric motors are important, too!



The McQuay, Inc., Spot Heater used in the Boeing Flying Fortress is operated by a Bodine Aircraft Type Motor.

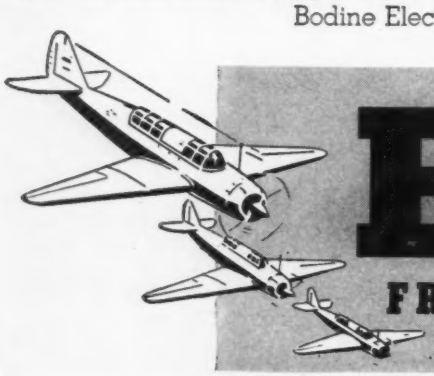
Today's military aircraft require great numbers of fractional horsepower motors to operate many vital accessories. Because these motors must be completely dependable, more and more manufacturers are using precision-built Bodine motors.

In the plane above, Bodine motors operate spot heaters. In other aircraft, you'll find them on fuel pumps, propeller featherers, and other accessories.

In military planes yet to be built, and in the peace time beyond, Bodine motors will be widely used, because they're reliable, light in weight, accurately constructed, and correctly engineered to their applications.

Bodine Has Been Supplying Industry With High Quality Fractional Horsepower Motors Since 1905

Bodine Electric Company, 2274 W. Ohio Street, Chicago, Illinois



BODINE

FRACTIONAL HORSEPOWER MOTORS

muscled, tanned, and steady. His head and eyes are clearer. He becomes a soldier in short order.

In day-long classroom sessions, the pre-flight cadet studies algebra, trigonometry, physics, radio code, avigation, the organization and function of the Army Ground Forces, meteorology, naval vessel and aircraft identification, (see p. 119, July AVIATION), sanitation, and other subjects that speed him on his way toward rating as a pilot.

On the range, he looks into the innards of, and shoots, the Garand M1 semi-automatic rifle, the .45-cal. automatic pistol, the .45-cal. sub-machine gun and, perhaps, the .30-cal. machine gun. He learns the nomenclature of all the weapons, to disassemble them and put them back together again.

The cadet also practices use of the gas mask and how to identify the odors of mustard, phosgene, and other deadly gases. He "pulls his tricks" at guard duty, maintaining a moving vigilance at some remote spot on the post during the day or night. And he "goes up" in the pressure chamber to test his reactions at high altitudes.

It's a concentrated, painstaking schedule from start to finish, and it's a fight against time, a battle against hours and minutes. There is, however, no compromise with quality. The goal is always "man for man, and plane for plane, the best Air Force in the world."

There's a cadet legend which alleges a student once dropped his pencil in a mathematics class and, by the time he had recovered it, he had missed an entire course in college algebra.

At any rate, when the bugler sounds Taps at 10 p.m., he plays his music to a grateful camp of cadets. The student has spent another profitable day in which he gained a keener sense of Air Forces' methods, plans, and goals, and he has put another girder in the foundation he needs to become an Army flyer. But he's a bit tired—with a comforting sense of having plugged away at a job well worth the doing.

In order that courses may be pointed to meet the needs of each individual air-task, separate pre-flight schools have been established for pilot cadets and for those who will be bombardiers and avigators. In the West Coast Training Center, pre-flight for pilots is at the Santa Ana, Calif., Army Air Base, while that for avigators and bombardiers is at Mather Field, Calif.

"The Hill"—the massive, sprawling San Antonio, Tex., Aviation Cadet Reception Center—is pre-flight to future pilots in the Gulf Coast Training Center, while the bombardier-avigator school is at Ellington Field, Tex.

In the Southeast Training Center, pilot pre-flight is located at Maxwell Field, Ala. Bombardiers and avigators

(*Turn to page* 326)

GOVERNMENT "SPECS" for STAINLESS STEELS

Revised Frasse Data Chart Now Available

Incorporating all recent corrections and additions, this new Frasse Data Chart enables you to identify latest Government "specs" for stainless steels at a glance.

It shows the chemical analysis requirements for each Army, Navy, Aeronautical, and Federal specification, together with nearest commercial equivalents in A.I.S.I. standard type numbers. Especially valuable are brief descriptions of the various subclasses under each "spec" number.

The chart is handy file size, printed on tough stock, and suitable for wall or desk use. If you're working to Government stainless steel "specs", you'll find it invaluable. Just send in the coupon—a copy will be sent to you by return mail.

A REMINDER —in cooperation with W P B The need for cutting tool conservation is urgent. If there is no comprehensive plan in your plant, start one today!

PETER A. FRASSE AND CO., INC. 17
17 Grand St., New York 13, N. Y.

Please send me a copy of your latest Frasse Data Chart, Section A, No. 2, showing Government "specs" for stainless steels and corresponding commercial designations.

NAME _____

FIRM _____

ADDRESS _____

Frasse

Mechanical and Aircraft STEELS

SEAMLESS MECHANICAL AND AIRCRAFT TUBING • COLD FINISHED BARS
ALLOY STEELS • AIRCRAFT STEELS • STAINLESS STEELS AND TUBING
DRILL ROD • COLD ROLLED STRIP AND SHEETS • WELDED STEEL TUBING

WELDON
Aircraft
FLUID METERING PUMPS

● For over twenty-five years the name "WELDON" has been synonymous with high quality—accurate—tool work of the greatest precision.

● Turning—Boring—Surfacing techniques to dimensional tolerances of one and two ten-thousandths of an inch are highly developed WELDON skills which insure the dependable performance and long life of WELDON AIRCRAFT FLUID METERING PUMPS.

For Engineering Data Sheets, write:

THE WELDON TOOL CO. *Cleveland, Ohio*

Pump Division

2046 EAST 71st STREET • CLEVELAND, OHIO

ONAN
ELECTRIC PLANTS

★ *Airborne*

OTC *Series*

"Electricity for Any Job—Anywhere."

ARMY E NAVY

ONAN GASOLINE DRIVEN ELECTRIC PLANTS provide electricity for all Aviation Applications, for Emergency, Standby, and regular service at Airports and Bases.

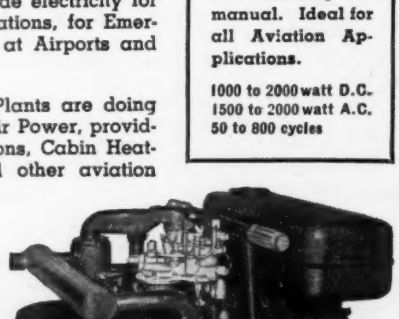
Gasoline Driven, Air Cooled, Light, Compact, Sturdy, Self starting or manual. Ideal for all Aviation Applications.

1000 to 2000 watt D.C.
1500 to 2000 watt A.C.
50 to 800 cycles

Thousands of these reliable, sturdy Plants are doing a winning job for America's mighty Air Power, providing current for Starting, Communications, Cabin Heating, operation of landing gear, and other aviation purposes.

Ratings from 350 to 35,000 watts. A.C. 50 to 800 cycles, 110 to 660 volts. D.C. 6 to 4000 volts. Also dual A.C. and D.C. output models. Air or water cooled.

Details gladly furnished on your present or post-war need for Electric Plants.



D. W. ONAN & SONS

1197 ROYALSTON AVENUE • MINNEAPOLIS, MINNESOTA

study at Selman Field, Monroe, La.

But, regardless of where he takes it, it's an important, strenuous step for the cadet.

When he leaves, to be assigned to an elementary flight school or to an advanced avigation or bombardier school, he knows exactly what it takes and how to play the game according to the rules.

Pre-flight "separates the men from the boys".

Ring Design

(*Continued from page* 174)

sided—seals the blowby, reducing wear and the danger of scuffing, scoring, lacquering, sticking, or seizure of these parts. Consequently, the things that have been done by engine manufacturers to prevent rings from sticking—such as use of large clearances between side of the ring and side of the groove, and use of tapered-side rings—can in the first case be reduced, or in the case of tapered side rings, be eliminated.

After the blowby is under control, then control of oil becomes important, because with elimination or reduction of blowby, oil consumption will have a tendency to increase. Consequently an oil ring must be designed with a high unit loading and a high total loading—a ring that will stay against the cylinder and scrape off surplus oil. The type of oil ring is not so important. In some cases ventilated type oil rings are used, in other cases rings are employed that are milled on the side for oil drainage; and in still other cases plain rings are used where oil drainage is controlled through the piston.

A typical example of results accomplished through use of a torsional compression ring is in an "A"-hp. engine* where the difficulty was lacquering, sticking, scuffing, scoring, and wear. The original rings had a very low loading. Extreme clearances had been used between ring and groove to eliminate sticking. Extreme clearances had been used between piston and cylinder wall to eliminate scuffing, but the problem still remained. A beveled back torsional compression ring was used in each one of the two top grooves. The loading of all rings was increased, and the surfaces were coated. Side clearance between ring and ring groove was decreased. The first test was so outstanding in its results that this combination of rings was immediately adopted. Lacquering, sticking, scuffing, and scoring had been eliminated by controlling the blowby.

A "B"-hp. engine was consuming an extreme amount of oil, and rings and

*Here and in the following paragraphs references are made to engine sizes ranging from approximately 50 to 1,800 hp. Data given is taken from reports of actual tests or production runs.

1200 horses get ready to fly!

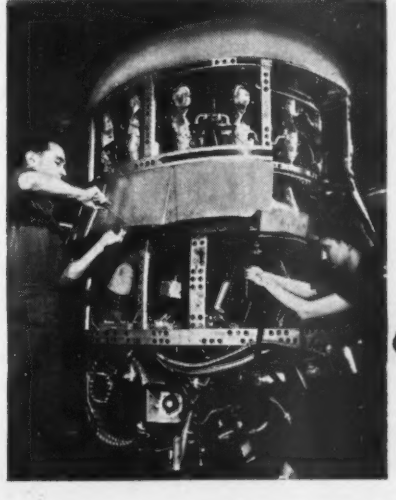
ROHR

PARTS ☆ ASSEMBLIES

ROHR craftsmen bridge the gap between power plant and airplane with thousands of intricate operations which include both manufacture and assembly.

The painstaking precision of their work contributes to the stamina and reliability of many of America's famous bombers, cargo carriers and giant patrol planes.

Day and night on Rohr's production lines, huge motors move forward to meet the ever increasing tempo of the war's demands . . . a tempo matched by the high spirit of Rohr Production Fighters who know that speed in the factories saves lives at the front!



HELPING TO WRITE

THE STORY OF TOMORROW

ROHR AIRCRAFT CORPORATION • CHULA VISTA, CALIFORNIA

R B C AIRCRAFT SERIES—#10 DOUGLAS C-54 SKYMASTER

RBC NEEDLE BEARINGS

A prophetic picture this—with the Douglas Skymaster flying high above row on row of trees instead of over crosses on a battlefield cemetery. This transport is one of the deciding factors in the logistics of global warfare which is speeding the day of peace with victory. RBC Needle Bearings are playing their part by meeting aircraft designers' rigid requirements incorporating (1) utmost static capacity, (2) minimum overall dimensions and weight, (3) ease of application and (4) minimum maintenance.

ROLLER BEARING CO. of AMERICA
TRENTON . . . . NEW JERSEY

cylinders were showing considerable wear. Blowby was very high, as was evidenced by large quantities of oil being thrown out of the breather. A beveled back torsional compression ring of increased loading was put into the top ring groove. Loading of the plain compression rings and oil rings in the other grooves was increased, and the ring surfaces were coated. Clearance between side of the ring and side of the groove was decreased. On the first test there was no evidence of any oil being blown from the breather, and the scuffing and wear were eliminated.

An engine of "C"-hp. was having the same problems of scuffing on rings and extreme wear and scuffing on cylinders. Ring loadings were low. The compression rings were showing uneven contact on the face and sides, with most of the contact at top edge of face of the ring. The severity of this job required a tapered face, beveled back, torsional ring in each one of the two top grooves, and a beveled back torsional ring in the third groove. The surfaces were coated. The first test ran for 75 hr. at full throttle, with no presence of any scuffing, scoring, or wear, and oil consumption was extremely low.

Lacquering, sticking, scuffing, and scoring were being experienced in a "D"-hp. engine. The ring loadings were low. Face and side contacts of the rings were not uniform. A beveled back, torsional compression ring was installed in each one of the two top grooves, and a plain compression ring in the third groove. Loadings were increased on all rings, and the surfaces coated. It is very rare today on these engines to change a single ring throughout either the "green" or acceptance run.

An "E"-hp. experimental engine was tested with many different types and kinds of compression and oil rings. The torsional compression rings produced the lowest oil consumption and blowby of all sets of rings tested.

On an "F"-hp. engine, among other things, the face corners of the rings had been rounded in an attempt to eliminate scuffing of the rings and cylinders. Here, as in the other cases, the problem was corrected by heavily loaded torsional compression rings. A beveled back torsional compression ring was used in the top groove, and a tapered face, beveled back torsional compression ring in the second groove. Loading was increased in all of the rings, and the surfaces coated. At completion of the 150-hr. model test there was no indication of scuffing on rings or cylinders. Blowby was reduced to the point that a negative crankcase pressure was indicated, and the oil consumption was abnormally low.

Extreme scuffing and severe blowby, as evidenced by oil being blown from

Fast Deliveries!
ON AVIATION SCREW PRODUCTS

STRONGHOLD SCREW PRODUCTS

2 Weeks—
ALUMINUM WASHERS

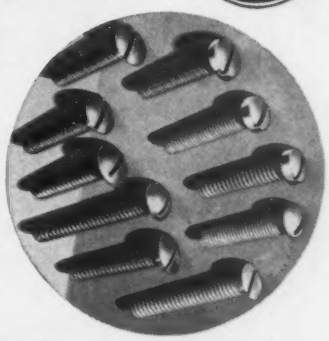
AN & AC	
70	526
280	530
302	531
335	535
340	540
345	545
350	550
380	560
385	565
500	566
501	935
505	936
510	940
515	945
520	960
500A	970
501A	8013

MADE to "AN" specifications in Aluminum and Aluminum Alloys. Large stocks; wide range of sizes. Also stock deliveries on steel washers and lock washers in most sizes.

4 to 6 Weeks—
MACHINE SCREWS

MADE to highest quality standards. Each operation checked and inspected constantly—no burrs on slots; no undersize or oversize; correct tolerances. *Drilled screws a specialty.* Send samples or sketches for prompt quotations on "SPECIALS".

It's Faster to Telephone . . .
Call WHITEHALL 4680



MANUFACTURERS SCREW PRODUCTS
204 West Hubbard St., Chicago 10, Illinois

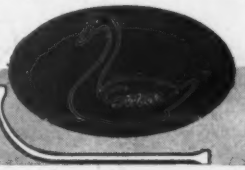
PIPE AND TUBE BENDING is what SWAN does best!

WE'RE old hands at this business of bending and fabricating pipes and tubes. Many leading manufacturers consider us experts in our line, and give us all their pipe and tube bending, coiling, expanding, flattening, brazing and welding to do.

SWAN is equipped to handle all types of metals. And all kinds of jobs, from machine bending on a large scale production basis to hand bending on a small scale for experimental work of a confidential nature.

We do designing, too, and assembling and testing. Take advantage of our *free advisory engineering service* to help you with your problems on any of the operations mentioned above. Write today for suggestions on any job in connection with the type of work we do.

SWAN ENGINEERING COMPANY, INC.
744 Frelinghuysen Avenue, Newark #5, N. J.



Do You Want TERMINALS?

ADDITIONAL facilities now set up enable us to offer our technical service and manufacturing capacity to a wider group of manufacturers in the aircraft and allied fields.

If you need TERMINALS that will meet all requirements as to accuracy — uniformity and strength — if you want them with reasonable dispatch —consult BUCKEYE.

We are prepared to meet your most exacting needs for terminals of various types and sizes. Check with BUCKEYE on your next lot of terminals —send us your blue-prints and specifications and we will be more than glad to quote you.

Correspondence invited.

Buckeye Tool & Supply Co.

2030 W. 55th St., Cleveland, Ohio

the breather, was the problem in a "G"-hp. engine. The crankcase pressures were extremely high. The ring loadings were extremely low. Tapered face, beveled back torsional compression rings were used in the two top grooves. A beveled back torsional compression ring was used in the third groove. Scalloped type oil rings were used. The loading was almost doubled, and the surfaces were coated. The first test throughout 50 hr. full throttle showed a negative crankcase pressure, and the rings were in perfect condition at the end of the test. Improvements in these rings have been made, until today on endurance tests of as long as 300 hr. wide open throttle it has been indicated that it is possible to maintain oil consumption figures as low as 10 percent of the original.

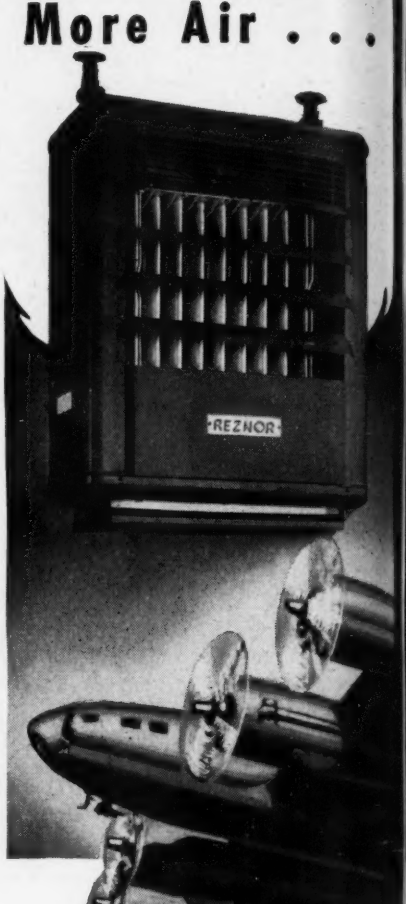
An "H"-hp. engine had an extremely short life due to scuffing and wearing out of rings and cylinders. This wear was so severe under certain conditions that it was impossible to complete, acceptably, a 6-hr. block test. Placing of a bevel on the upper inner corner of the compression ring in the three top grooves, and increasing of the load as much as was possible with the groove limitations, made possible the successful completion of several 50-hr. tests at normal rated power. Both chrome-plated and coated rings were tested. In all cases the cylinder wear was negligible. The oil consumption was satisfactory, and it was maintained at a uniform level throughout all tests.

There are several tests being conducted on extremely high output engines, all indicating that the same benefits are obtained with the torsional type compression ring on these engines as were obtained on other engines. In all instances there is reduction of blowby and a reduction or elimination of scuffing, scoring, lacquering, sticking, etc.

It will be noted that coatings and loadings are mentioned in each case. It is true that a torsional ring must have a load sufficiently high so that it will hold its position in the groove, and all rings must have a load sufficiently high to maintain cylinder wall contact at all times. The coating referred to is electrolytically deposited tin. It helps to form a more perfect seal between ring and cylinder wall and between ring and ring groove and aids in protecting these parts during the run-in.

These instances are all merely representative of the many tests and production runs where the torsional type of compression ring has been used, together with a suitable oil ring. Results of the numerous tests have been so consistent that it is indicated without question that both blowby and oil consumption can be controlled throughout a reasonable period of time in all types

(HERE'S PROOF) That REZNOR Unit Heaters Move More Air . . .



ANOTHER PROBLEM SOLVED

DRYING AIRPLANE GAS TANKS IN LESS TIME . . . . . .

★ You would hardly think to look on a steel fabricator's production line for proof that Reznor Gas Fired Suspended Unit Heaters move more air. But, because of this ability to move air in abundance, Reznor Heaters are used for manufacturing operations as well as for space heating. For example, Reznor Units save one manufacturer 90% of the production time formerly used for drying airplane gasoline tanks. But that's not all. Woodworking manufacturers, container manufacturers, and a host of others use Reznor Heaters directly as part of their war production equipment. Hence, for more warm air over wider areas, depend upon Reznor Units. Write for literature.

REZNOR MANUFACTURING CO.

403 James St. Mercer, Penna.

"GAS HEATERS EXCLUSIVELY SINCE 1888"

A barrel of Man Hours

There's a barrel of extra man hours in every carboy, drum, and barrel with the familiar green Kelite label.

These *engineered* cleaning and processing chemicals operate under scientific pH Control—the laboratory way to get optimum results, in minimum time, consistently.

For example, Kelite Process K-1 (patented) gives millions of spot welds—without one blown hole—on fast aircraft production lines. Saves thousands of hours.

For example, Kelite Super Ketrex cleans carbon and sludge like magic from aluminum and magnesium engine parts—without trace of etch or corrosion.

For example, Kelite No. 118-C4, non-foaming water curtain material, makes continuous operation of paint spray booths possible.

For example, Kelite Bubble Fluids detect leaks on primed and unprimed surfaces—fast and sure.

There are more than 100 Kelite materials for cleaning and processing. They *can* speed your production, often improve the performance of the finished product. Ask about them. Scores of treatises, technical bulletins, await your inquiry. Write today.

COPYRIGHTED 1943, KELITE PRODUCTS, INC.

KELITE

ADVANCED INDUSTRIAL CHEMICALS FOR CLEANING AND PROCESSING

Check technical bulletins you want and attach coupon to your letterhead.

- ☐ *Kelite Process K-1 for resistance welding.*
- ☐ *Super Ketrex for cleaning Aircraft Engines.*
- ☐ *Kelite Bubble Fluid for detecting leaks.*
- ☐ *Information on.....*

KELITE PRODUCTS, INC.
909 East 60th Street, Los Angeles

BRANCHES IN ALL PRINCIPAL CITIES • MANUFACTURING PLANTS IN LOS ANGELES, NEW YORK, CHICAGO AND HOUSTON

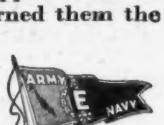
IT'S no accident that that statement appears regularly in communiques from battles areas. It's been planned that way.

American planes and engines have been carefully designed—built to the most exacting specifications. American pilots and crew members—the world's finest—have been carefully selected, thoroughly trained.

After every flight, ground crew men—men who received intensive training, passed rigid examinations for mechanical ability—take over. Engines, planes and instruments are checked with infinite care—adjustments made wherever necessary—every precaution taken to insure mechanical perfection on the next expedition over enemy territory.

It's a safe bet that BONNEY TOOLS play a leading part in making sure of that perfection—help make necessary adjustments quickly, easily—help make possible many of those thrilling, heart-warming reports. Because with tens of thousands of engines produced by leading aircraft engine manufacturers BONNEY TOOLS are standard, original equipment with every engine shipped—selected because of quality proven through the years—quality that has earned them the reputation "the finest that money can buy".

The best engines and planes, skilled fliers, expert ground crews and BONNEY TOOLS—an unbeatable combination. All play their part in helping make possible the safe return of planes carrying America's Fighting Men of the Air.



BONNEY FORGE & TOOL WORKS, ALLENTOWN, PENNSYLVANIA

Only a fleeting glance but the Pilot has a perfect image of what's coming up in a

LIBERTY AIRCRAFT MIRROR

In many of the planes now in action over our widely scattered battle fronts, the pilots are getting a perfect image of things in the rear without eyestrain or fatigue by means of Liberty Aircraft Mirrors.

The highest possible quality is essential with so many human lives at stake. That's why all Liberty Aircraft Mirrors are first surface mirrors and as permanent as their glass base. The pilot needs a clean, well defined image without distortion, immediately. He gets it from Liberty Mirrors.

Each warplane equipped with a Liberty Mirror has a mirror built to meet the specific requirements of that plane. Thus the pilot changing from one plane to another gets uniformly good vision at all times, in all planes.

For the duration all Liberty Mirrors go to War—but later these battle tested vision devices will be available for all plane operators.

LIBERTY MIRROR WORKS

BRACKENRIDGE PENNSYLVANIA

Represented on the Pacific Coast by
W. P. FULLER & CO.

Phoenix, Arizona
Los Angeles, California
San Diego, California
Fresno, California
Sacramento, California
Oakland, California
Boise, Idaho
Butte, Montana
Salt Lake City, Utah
Seattle Washington
Spokane, Washington
Tacoma, Washington
Yakima, Washington
Portland, Oregon

San Francisco California

of engines by use of the beveled back torsional compression ring and an oil ring, both highly loaded and with their surfaces coated to withstand the particular conditions under which they operate.

Our Planes And Our Peace

(*Continued from page* 123)

aircraft factories for conversion into commercial models? Shall they be leased to airlines or sold outright? Shall one military conversion be sold to the airlines with the proviso that another new aircraft will be purchased from the manufacturers? Shall much of the equipment be exported?

I am not sure of the answers to these questions, or to others of similar nature which are now arising.

I am urging, however, that aircraft manufacturers, who best know their problems, express themselves for the guidance of the government. We all know that the method of disposal alone can make us or can break us. Once a fair and equitable system of disposal has been determined, it should be held to until the war-surplus problem has been met. All of us can look back to the end of the last war and see the thousands of airframes, engines, and other equipment which were precipitously unloaded. This worked two hardships. When pilots might have had airplanes of advanced type, they were forced to accept and fly obsolete and out-dated equipment. Manufacturers were unable to compete with the government's disposal for the following eight years, and thus the development of aviation was retarded.

The manufacturer can see certain markets looming in the military, commercial, and private fields. Some time ago I made a suggestion that this time we enforce our treaties and our covenants and that we put some teeth in them. After the last war we neglected this important phase of keeping peace, once we had won it, and Hitler, Mussolini, and Tojo dreamed, schemed, and finally armed right under our noses. This time, we are going to have to nip any of these would-be dictators instantly.

My methods of doing this would be through establishment by the peace-loving nations of a world-wide aerial police force, based in every part of the world. I believe that 30,000 airplanes could be used in such a policing operation, with approximately 6,000 airplanes becoming obsolete each year. In addition, I have suggested an air force of our own, adequate for defense, research and experiment, and training. This

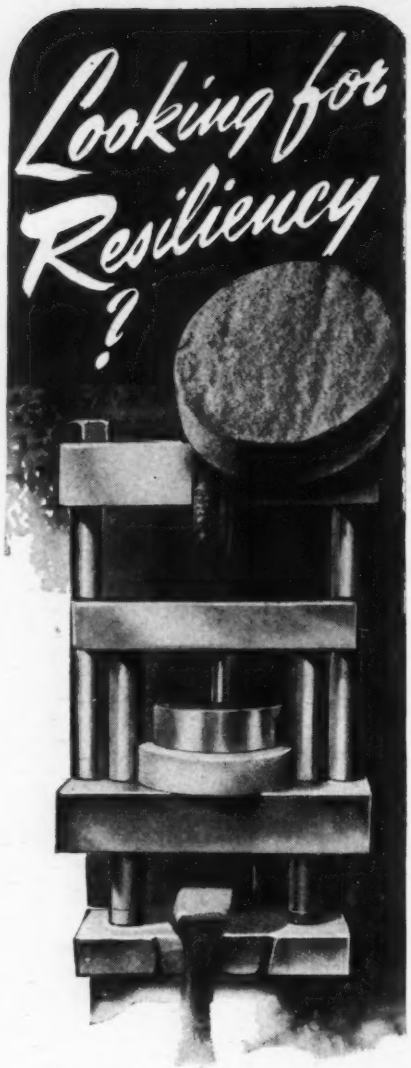
● INTRICATE AIRCRAFT FORGINGS

● WELDED TUBULAR ASSEMBLIES

AIRCRAFT MECHANICS · INC ·

Designers—Engineers—Manufacturers

Colorado Springs Colorado



IN EXTENSIVE laboratory tests, the compression of certain (½-inch thick) Booth felt samples under load of 150 lbs. per sq. in. resulted (after load removal) in "permanent" loss in thickness of only .005 inch!

Yes, Booth "prescription" felt manufacture can be controlled to give you the amount of resiliency, or almost any other quality, desired in your material.

THE BOOTH FELT COMPANY
482 19th Street Brooklyn, N. Y.
745 Sherman Street Chicago, Ill.

2071

Booth
TRADE MARK

PRECISION CUT FELT PARTS

would call for several thousand more aircraft. Both forces would give employment to many thousands of present workers in plane manufacturing plants and to personnel in our air forces who wish to continue in flying careers.

Aside from these fields, the manufacturer can see a considerable commercial market, both abroad and here. The peacetime exports from 1935 until and including 1939 amounted to between one-fourth and one-third of our total output. However, in 1935 we manufactured only 1,109 airplanes, and only 3,715 in 1939, the bulk of these being in the light plane category. It is all very well to dream idly about the size of the aircraft we are going to build and the numbers we are going to build, but it is essential that, in dreaming, we do not forget that at the start of the war we were carrying the bulk of the domestic business in only 361 airplanes. In fact, Pan American Airways had only 141 airplanes in operation to cover the Atlantic, the Pacific, and South America.

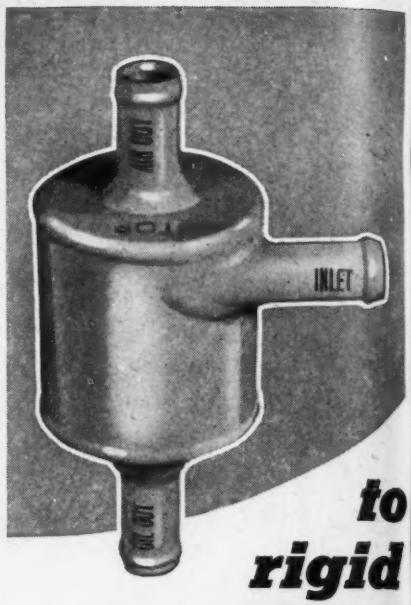
It is also well to remember that the airlines are doing their present job with less than half the equipment they had on Dec. 7, 1941, and they are doing it well.

It is worthwhile that we set down such figures as these:

In the last year prior to the outbreak of this war, 291,000 passengers came by ocean liner from Europe to the United States and 276,000 traveled from the United States to Europe. A pencil and paper will show you that every last one of these passengers could have been carried by air, without over-working equipment, with ten 400-passenger planes, or one hundred 40-passenger planes, or two hundred 20-passenger planes.

When anyone starts giving me astronomical figures on the number of people who will be flying and the number of planes which will be needed to transport them, I think of these figures. Then my head may be up in the clouds, but my feet are firmly on the ground. Then, too, if you are going to project yourself into this rosy aviation future, it is well to consider a few other elementary figures, such as airmail, air express, and passenger rates running from 50 to 80c. per ton-mile in relation to passenger and freight rates on such surface facilities as buses, trucks, railroad trains, and ocean liners. For instance, railroads carry a ton of certain types of basic freight for less than 1c. per ton mile, while steamship companies figure their freight rates in mills per ton mile.

In reciting these figures I am not being a pessimist—I am just being hard-headed. I'm a business man, a production man, a manufacturer. I cannot,



to rigid standards

MERCURY served a twenty year apprenticeship for war... designing, perfecting and building equipment for the Army and Navy... tooling, equipping and training personnel to produce many essential products against the day of boundless need.

for instance...

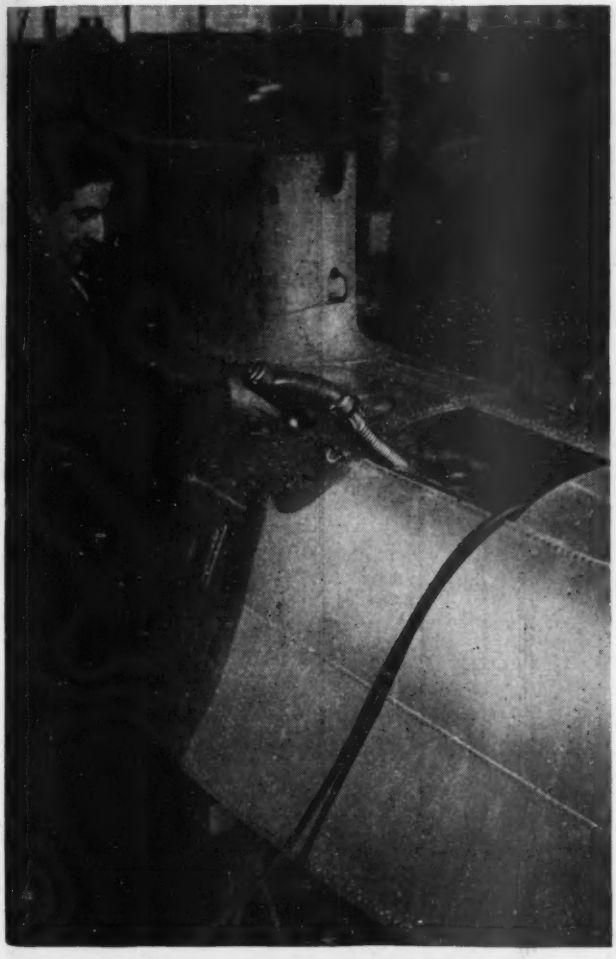
take oil separators for the vacuum pump in de-icing equipment. For years, we have supplied these small but vital parts to Army and Navy. Today, most builders of military airplanes in this country and in Canada call on us for these essential devices.

At the Cradle of Aviation

MERCURY AIRCRAFT INC.
HAMMONDSPORT · NEW YORK

FLOATS MUST FLOAT

. . . Edo makes them watertight



Seaplane floats must meet the test of war-service conditions on rough water and hard beaches—and *must not leak.* Watertightness is assured by processing metals to make them resistant to wear and corrosion and by numerous special, precise operations—including the sealing and minute testing of every rivet! Simplicity of design and accessibility to every part of an Edo float saves valuable work-hours in these vital processes and aids efficient inspection.

At left: An Edo float on a special jig undergoes a water test. Every compartment is filled individually and subjected to closest inspection, inside and out, for leakage. *At lower left:* An operator inside a compartment tests the watertightness of adjoining sections which have been filled with water. *Lower right:* A joint between adjoining sheets is treated with a ribbon of sealing compound .010″ thick which remains plastic and keeps the joint leak-proof.

Making floats watertight—is a job at which Edo has had 18 years of continuous experience in preparation for its big job of today in building the world's finest all-metal floats for our military seaplanes.

EDO AIRCRAFT CORPORATION
402 SECOND STREET
COLLEGE POINT, L. I., N. Y.

* EDO FLOAT GEAR *

SERVES THE UNITED NATIONS

Pound for Pound,
aircraft surfaces produced by
Andover Kent
are stronger than metal

Molded Aircraft Plywood Stronger Than Metal, Tests Show

Plywood Withstands Stress of 187%, Airplane Metal Fails at 129%, in Static Load Test

New Brunswick, N. J., June 28—The astounding strength characteristics of molded plastic plywood, produced at the Andover-Kent Aviation Corporation's local factory, were demonstrated today when a standard aircraft part, constructed of aircraft metal, came out a bad second in a contest of strength with an identical part fabricated of molded plastic-bonded plywood by the local concern.

By means of "static load tests," both structures were fore-doomed to destruction. Purpose of the tests was to determine the amount of stress required to cause the parts to fail.

The tests were begun at the rated 100% of full load required by Government specification, and additional strain, in the shape of heavy weights, was added to the competing structures in exactly equal amounts. Two dials, ingeniously rigged up to give direct readings of the amount of strain being imposed, gave a running story of the contest.

Both dials stood at 129 as the engineers, intently watched by a knot of spectators, added further weights. Suddenly, startlingly, the metal gave way, tearing, buckling and crumpling into complete junk.

Unperturbed, the engineers calmly continued testing the plywood. The dial crept up to 140, 160, 185, as the spectators edged gingerly away. When the dial hit 187, a sharp crack was the only announcement that the plywood had finally failed. Inspection of the structure showed that only a small corner had given way.

Reached for comment after the test, William L. Smith, vice-president and general manager of the aviation company, said, "We are pleased, of course, but not surprised. We have long maintained, and now we have proved, that pound for pound, the aircraft surfaces which we design and mass-produce here in this factory, are stronger than metal. Britain's "Mosquito" bomber is proof that molded plastic-bonded plywood is battle-worthy. No, we are not permitted to tell you the name of the aircraft for which we are building these parts."

The highly-publicized premises

● Our staff of aircraft designers and engineers, our corps of skilled workers, and our complete facilities for mass production of even the most complex double-curvature aircraft surfaces, are unexcelled in the industry. Let us tackle your production problem in terms of molded plastic-bonded plywood. Write or phone us today—better yet, arrange to visit us.

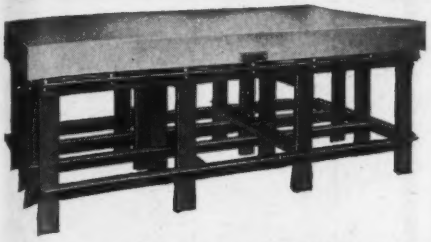
THE FAMOUS "LANGLEY"
built by ANDOVER KENT

for LEADERSHIP in molded plastic-bonded plywood

ANDOVER KENT AVIATION CORP.

NEW BRUNSWICK • NEW JERSEY

PRIORITY ON PRECISION



... use CHALLENGE Semi-Steel LAYOUT SURFACE PLATES

● Highly recommended for use where a true, rigid, smooth surface is required for layout, inspection or assembly. Planer finish—dependable and accurate. Sold with or without reinforced all-steel stand—arc-welded to give the strength and solidity of one-piece construction. Stand is provided with lock leveling screws which enable user to level the plate quickly and lock it securely. Plates are made in 8 standard sizes, up to 54x144 inches, all six inches thick. Special sizes, including extra large, made to order.

★ ★ ★

... and CHALLENGE LAPPING PLATES

● Specially designed to assure a perfect fit when lapping metal-to-metal joints on which no sealer is used. Made of special analysis semi-steel, carefully machined. Grooves are 1/16-inch, 1/2-inch apart, running full length and width of the surface. Plates are available with or without all-steel, arc-welded stand equipped with lock leveling screws. Many sizes.

LATEST CATALOG illustrates and describes complete line of Challenge Precision Equipment. Send for it today! 419-C

THE CHALLENGE MACHINERY CO.
1893 50TH ANNIVERSARY 1943
GRAND HAVEN, MICH., U. S. A.

when I look at the facts, believe that when this war ends we are going to build 100,000 airplanes in 18 months, or produce them at the rate of 7,000 per month, and if we are to make any concrete progress toward solving our problems we are going to have to start out with facts, not fancies. We cannot be frivolous and, at the same time, convince sound minds that we are talking sense.

The manufacturers and the air transport operators have one joint problem which is already not only being recognized but attacked. I refer to the fact that the world in general has forgotten that the airplane can be a medium of goodwill and international understanding. Today, the peoples of the world talk of combat planes, of interceptors, bombers. They talk of block-busters, torpedoes, skip-bombing, and area bombing. They must be re-educated to look on the airplane as a messenger of peace. Consolidated Vultee has already started an aggressive campaign of promotional and educational nature through the medium of advertising. With the coming of peace, there will be ample opportunities of demonstration, and it would be well for every manufacturer and transport operator to join hands in re-selling the airplane with an olive branch in its nose, bringing the peoples of the world closer together.

Even as the future of military and commercial aviation is open to conjecture, so is the future of the private field. I have long contended that before the average man will buy an airplane, be it of conventional type or a helicopter, he will first buy an automobile and spend about 15 percent of his income operating and maintaining it.

Consolidated Vultee is planning a helicopter. We have four of eleven divisions which are adaptable to conversion to the manufacture of light planes. There are, however, so many complications to the picture that I am not going to try to discuss them in detail here. One must, however, give consideration to such prime points as to what the economic status of the average individual will be after the war; what his taxes will amount to; what facilities are afforded him throughout the nation for his travels in his own plane by air; the amount of equipment he must install on his craft to conform to regulations; and the actual costs of manufacture of the light plane when the war ends.

An unfortunate tendency at present is that of the various states to set up their "little Civil Aeronautics Acts," usually under such bodies as state railroad commissions, with such ideas as taxing gasoline, licensing aircraft and pilots, and establishing a host of regulations. On the other hand, the Lea

Hollow tumbling barrel axles, or journals, made from this tubing have the strength to stand up under a constant combination of weight and movement.

The *uniform wall thickness* of this tubing means more strength—and a greater factor of safety. Carpenter Welded Stainless Tubing often permits the use of *lighter gauges* without sacrificing strength. Then too, the high strength-weight ratio of the Stainless Steel from which this tubing is made helps to strengthen parts, save weight and space in aircraft assemblies.

Easier, faster fabricating also results from using this tubing. Lighter gauges mean faster bending, forming, welding, etc. And the *uniform structure* of Carpenter Welded Stainless Tubing can save you many production worries. Even the V-shaped weld is chemically and mechanically analogous to the parent metal.

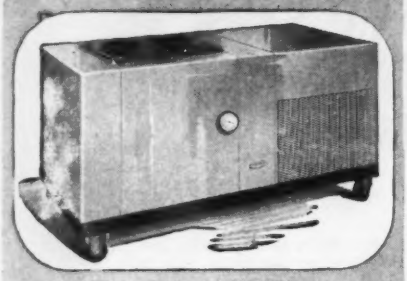
Since the days of Carpenter's development of this type of tubing, we have been sharing our diversified experience with others. So drop us a line for help with your design-engineering problems.

USE THIS FOLDER . . .
to help you select the type of Welded Stainless Tubing for your needs. It contains data on physical properties, corrosion resistance qualities; sizes and shapes available. A note on your company letterhead will start this useful information on its way to you.

THE CARPENTER STEEL COMPANY
Welded Alloy Tube Division, Kenilworth, N. J.

Carpenter
WELDED
STAINLESS TUBING

KOLD-HOLD



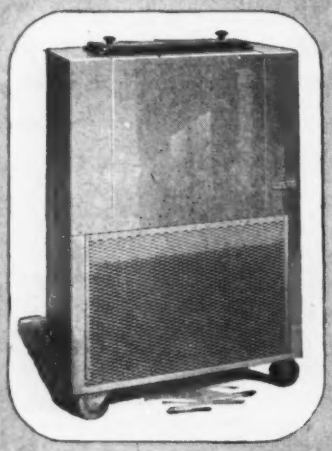
Horizontal Type

for Sub-Zero and Thermal Processing

Processing of batteries, wires, and various devices is accomplished quickly and accurately with KOLD-HOLD Industrial Sub-Zero Machines. Also, use this equipment for quick-aging of steel and securing expansion fits.

Aircraft plants also use KOLD-HOLD equipment for processing and storage of 24S-T and 17S-T aluminum alloy rivets, sheets and spars. Special KOLD-HOLD units are available for testing of FT-243 crystals, for reproducing Stratosphere conditions at will, and for dual-temperature processing of sub-assemblies.

Whatever your thermal, sub-zero and Stratosphere processing and testing requirements may be, investigate the equipment that KOLD-HOLD of Lansing has designed and manufactured especially for the work involved. A card will bring you a complete catalog. Send now.



Vertical Type

NEW YORK: 254 W. 31st—PE 6-1161
CHICAGO: 201 N. Wells—RAN 3986
PHILADELPHIA: 2414 Clover Lane, Upper Darby—SHE 0622
LOS ANGELES: 1015 W. 2nd—MI 4989

KOLD-HOLD MANUFACTURING CO.
442 N. Grand Ave., LANSING, MICH., U.S.A.

bill which is now before Congress, is destined to modernize and amend the Civil Aeronautics Act. It contains wise and sensible measures for proper regulation of all forms of aviation. It not only regulates but it also encourages. Behind the bill and the act are 17 yr. of operation. First, I do not believe that any state can improve upon it. Second, I believe that 48 sets of regulations are not essential when one set can do the job. The airplane's horizons are not state-wide—they are national and they are global.

We are entering an international phase of aircraft operation. We are going to have to go out and get our share of that business. To me, two policies are mandatory. One is private ownership of such operations; the second is maintenance of free competition. I think, too, that insistence should be made on "free ports" throughout the world, so that all United Nations can have an opportunity to participate fairly in the world's aerial trade.

These problems will be worked out at the peace table, and leaders in American aviation must do their part to see that this country's interests are upheld. I am sure that no American air transport operator wants more than his fair share. Certainly he is willing to test his chances in the world transport field on the basis of his efficiency, economy, and the service he can give.

In conclusion, let me state that I feel that if we have free enterprise, are not hamstrung by regulations, and are allowed an opportunity to plan for the peace, we will not face too great a recession. I am sure that we are all aggressive enough to get new business. There are now some hopeful signs. It may be that renegotiation procedure will be modified to a point where we can build up the reserves needed to continue as efficiently and soundly in peace as in war. The Civil Aeronautics Board is restoring applications for domestic airlines service; consideration is being given to war-surplus disposal and to reconversion; and there are signs that the government may cooperate in permitting design and production for peacetime before long. All these are straws in the wind, but they point in the right direction.

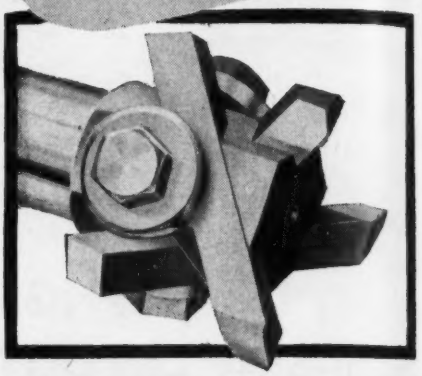
Bombing—The American Way

(*Continued from page* 121)

or not this fundamental objective was achieved. The Battle of France was won by the Germans after they had overcome all power of resistance. The Nazis, on the other hand, lost the Battle of Britain because they did not sufficiently reduce the RAF's ability to resist.

The most efficient method of bombard-

a totally different kind of surface facer



IMPOSSIBLE? *You bet not!*
Every claim made for this tool *can be proved!*

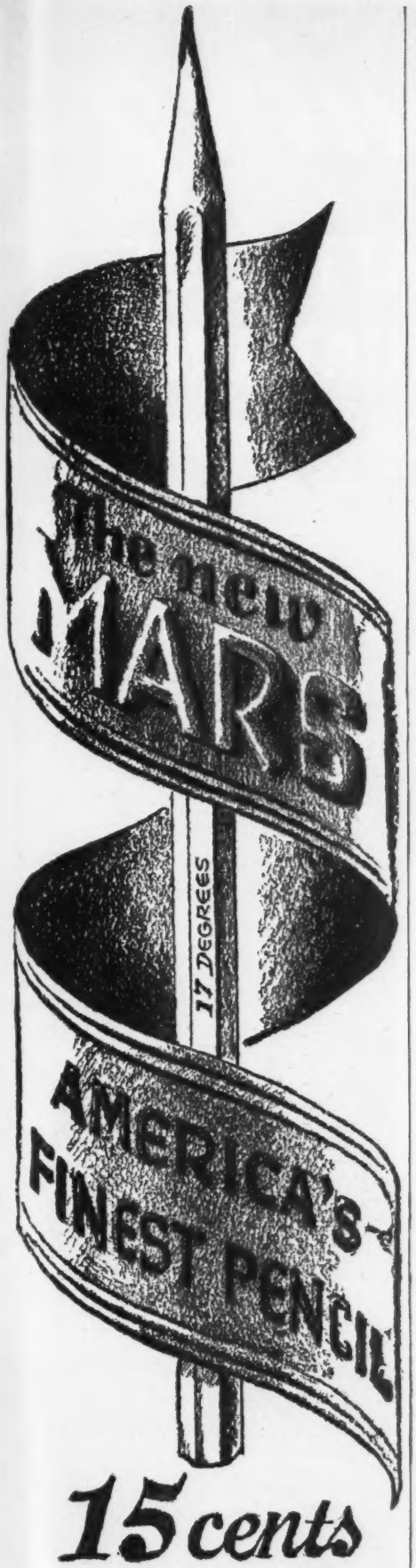
1 Replaces End, Shell, Slab Mills, and Inserted Tooth Cutters;
2 Fits all vertical and horizontal milling machines, drill presses and other spindle machines;
3 Quickly and accurately adjustable, just four tool sizes cover all fractional diameters from 1¼" to 5";
4 Slashes tool costs up to 75 per cent;
5 Clark tool blades are not ruined by hard spots in castings, re-extruded Dural, etc.—bits may be quickly touched up and sharpened free hand;
6 Tool blade life is unusually long, replacement cost low;
7 Cuts any material under the most severe operating conditions accurately, swiftly, economically;
8 Ample blade clearance avoids chip clogging and resultant slow-downs;
9 Tools available with all types of blades, including carbide tips;
10 Prompt delivery on suitable priority.

CALL YOUR JOBBER TODAY
WRITE FOR BULLETIN NO. 000

Clark Adjustable
FACING TOOL

GET THE FACTS
about Clark Adjustable Hole & Fly Cutters—they, too, are remarkable new-type tools!
CANADIAN DISTRIBUTOR: DOMINION BEARINGS, LTD.
Toronto • Montreal • Winnepeg

Robert H. Clark Co.
3424 SUNSET BOULEVARD • LOS ANGELES 26
Manufacturers: Precision Tools, Precision Parts



15 cents

"DEMAND THE BEST!"

J. S. STAEDTLER, INC.
55-55 WORTH STREET
NEW YORK, N.Y.

ment had to be foregone by both the Germans and the British because, in the design of method, the factor of resistance was not fully accounted for and was therefore not overcome. In broad analysis, immediate fundamentals were overlooked. In other words, in attempting to strike at the enemy's basic power of resistance, i.e., his source of military supply, means were not provided for reducing his immediate fighter resistance to such attempts.

What happened? Bombardment went on the defensive! It sought the cover of night and had to acquire sufficient mass and expend vastly more effort, men, and material to compensate for the loss of efficiency and to reach any degree of effectiveness in carrying out its ultimate function. Through superb effort and with assistance from her Allies, Britain was able to acquire and expend this mass of effort. The Nazis could not, and by any scale of comparison the German bombardment effort has ceased to be significant.

With history in mind again, one cannot help wonder how long this recourse to night bombardment will enjoy even what success it has had. How long will it be before effective resistance measures are developed to render this tactic prohibitively costly? If this never happens it will be one of the few instances in history, if not the only one, where efficient countermeasures were not developed.

The AAF bomber commands look upon their function as an offensive one—from beginning to end. The mission is to break down enemy resistance no matter what form it may take. Strategically, it is to destroy the enemy's source of supply as well as any resistance the enemy may make to that accomplishment. The AAF does not believe that the enemy can be destroyed by hiding from him; like the boxer, it is out to break down the opponent's guard *and* to knock him out! *It has the tools to do both.* They represent the most efficient tools man has devised and they are intended to be used to do the job by the most efficient method.

Recent Books

(*Continued from page* 287)

EMPLOYMENT IN MANUFACTURING, 1899-1939, *by Solomon Fabricant. National Bureau of Economic Research, New York.* 362 *pages, appendices, index,* $3.

In thorough statistical detail, Dr. Fabricant has made an academic analysis of production-employment trends, pointing out that technological advancements and economic expansion have quadrupled output and doubled employment in 40

(*Turn to page* 342)

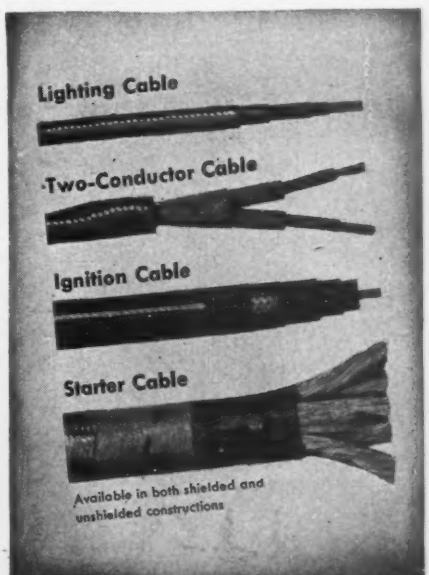
IT'S WIRY JOE FOR AVIATION WIRE and CABLE

There *was* a time that Wiry Joe was merely the largest independent manufacturer of replacement wiring for the automotive industry.

Now, Wiry Joe is also known as an important source of supply for every type of electrical wire and cable for aircraft. The complete line includes starter cable, high-tension cable, primary cable, both original and replacement. Wiry Joe also makes power and welding cable.

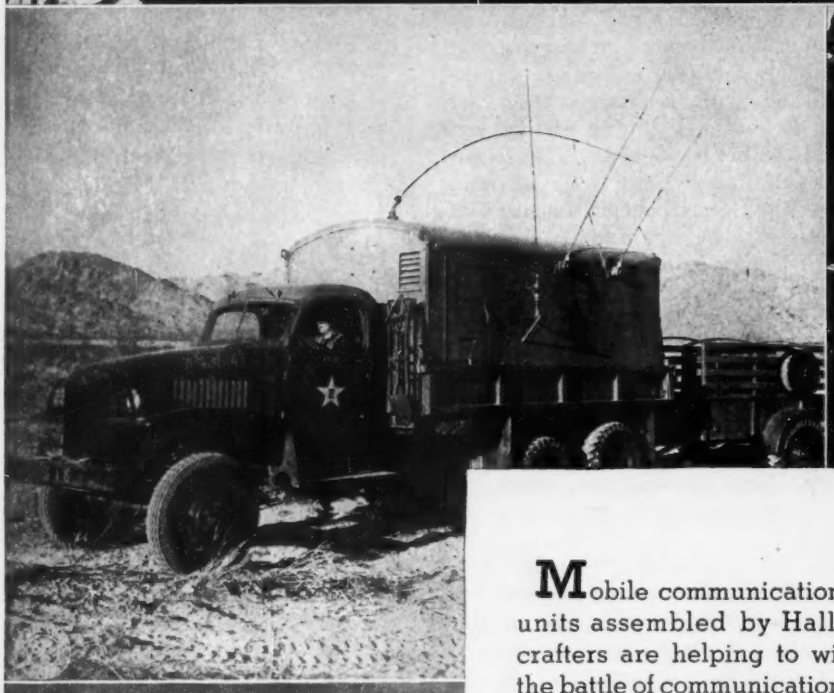
And just as Wiry Joe automotive cable won a name for quality, so, too, has Wiry Joe aviation cable. Every item in the line is built to meet rigid Army and Navy specifications, and is produced under the Dostam method of manufacture for uniformity, dependability, high efficiency and long life.

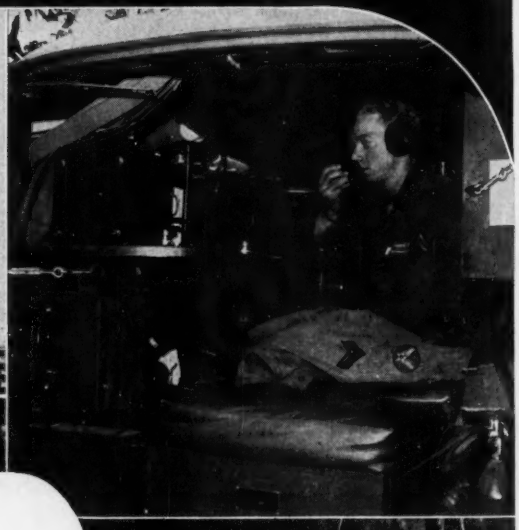
Inquiries regarding wire and cable for any type of service will be answered promptly.

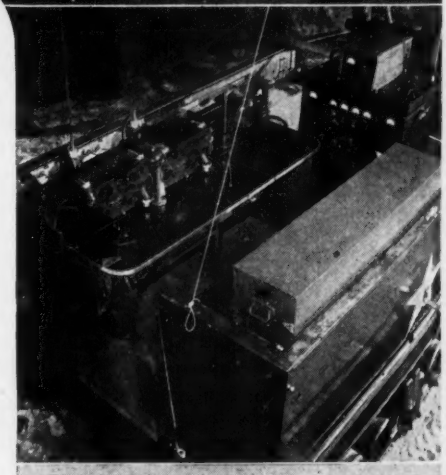


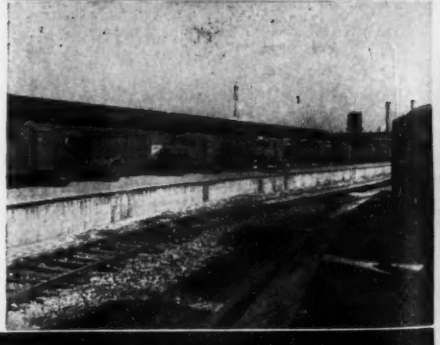
Wiry Joe
AVIATION CABLE
manufactured by
THE CRESCENT COMPANY
Pawtucket, Rhode Island

Winning "THE BATTLE OF COMMUNICATIONS!"









Mobile communications units assembled by Hallicrafters are helping to win the battle of communications on every fighting front. They are built to endure the rigors of modern warfare . . . The consistent performance of SCR-299 has been highly praised by leading members of our armed forces for its adaptability in meeting all the requirements of combat duty . . . A phrase best describing the SCR-299 was given when a leading military authority said, "It is to communications what the jeep is to transportation."

BUY MORE BONDS!

hallicrafters

CHICAGO, U.S.A.

THE WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF SHORT WAVE RADIO COMMUNICATIONS EQUIPMENT

ON FLYING FRONTS

Day and night they come and go — planes for patrol and reconnaissance, bombers on missions of destruction, pursuit planes heading into dog-fights. To do these jobs planes must be serviced for maximum safety and efficiency. In such work Williams' Tools play an important part. On flying fronts they help safeguard the lives of men who risk all. Maintenance crews rely on their accuracy and adaptability to speedily master difficult jobs.

Williams' Tools are prized possessions. Supplies are limited as the need of the war effort must be served first. Carefully used, the ones you now have will last until after Victory when there will again be tools for all.

WILLIAMS
SUPERIOR DROP-FORGED TOOLS
DROP-FORGINGS
& DROP-FORGED TOOLS

J. H. WILLIAMS & CO. BUFFALO, NEW YORK

Williams will gladly send their booklet of helpful suggestions: "How To Select and Use Wrenches". Just write.

yr. while work hours have dropped one-third. Concerning industrial evolution "it seems likely," he says, "that in the early stages of an industry's growth, capital investment is accompanied by an increase in jobs; that in the mature period it coincides with static or declining employment; and that in the later stages dis-investment of capital parallels displacement of labor and dwindling output."

AEROPLANES AND HOW THEY FLY. Longmans, Green and Co., New York. 44 pages, diagrams, paper bound, 40c.

Designed as an introduction to the theory of aeronautics, this pamphlet provides non-technical explanations of how balloons and planes get off the ground and how they are kept in and controlled in the air.

AIRCRAFT CONSTRUCTION HANDBOOK, by Thomas A. Dickinson. Thomas Y. Crowell Co., New York, 237 pages, illustrations, index, $2.50.

As "an introduction to the business of building airplanes," Mr. Dickinson, a naval inspector, has prepared an extremely simple and brief guide explaining how an aircraft factory operates, the principles of aerodynamics, aircraft types and nomenclature, design principles, materials and processes, shop practice, assembly, and inspection. There are also an appendix on properties and treating of materials, a glossary, and a bibliography.

AIR NAVIGATION, by Herbert S. Zim. Harcourt, Brace, New York. 324 pages, index, glossary, illustrations, $3.

Taking sights over the whole range of subjects the avigator must master, Mr. Zim briefly explains weather, use of charts, and principles of radio and celestial avigation.

FLYING FORTRESS, by Thomas Collison. Charles Scribner's Sons, New York. 16[illegible] pages, illustrations, $2.50.

A popular account of the genesis and triumphs of America's famed bomber studded with staccato reports and photos of its features and its missions. Tracing the know-how of its builders back to their experiences with the *Monomail* of 1928, Mr. Collison outlines the engineering evolution which resulted in the B-17F's, describes present building and testing practices, and includes a picture section of AAF bomber crew training.

(*Turn to page* 345)

★ An entirely new design for tandem controls. New mold provides unit castings that nest and lock together. Metal end-pieces and tie-rods insure rigid assembly—even up to 20 units in tandem. Single shaft passes through and locks with rotor of each control.

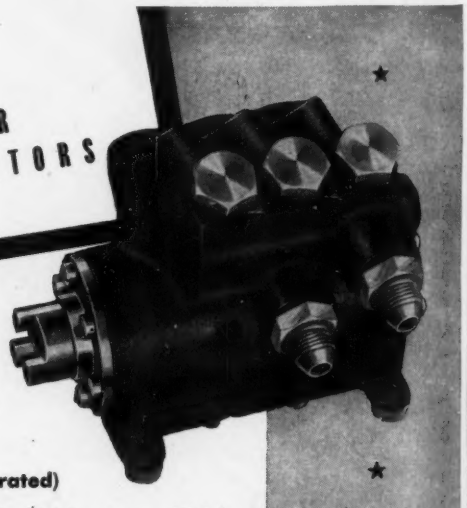
Each section accurately wound to precise circuit requirements—resistance, taper, taps, hop-off. Interlocking resistance ratios provide any desired voltage or current at given degree of rotation. These Multiple Controls are now in regular production and meeting the most rigid multi-control requirements.

★ **Send us that problem . . .**

CLAROSTAT *Controls and Resistors*

CLAROSTAT MFG. CO., Inc. · 285-7 N. 6th St., Brooklyn, N.Y.

CLARKE
3 CYLINDER
HYDRAULIC MOTORS



For driving pumps and for a wide variety of other applications on aircraft, Clarke Aero-Hydraulic Motors are found adaptable because of small dimensions, high power output.

TYPE CO2 (Illustrated)

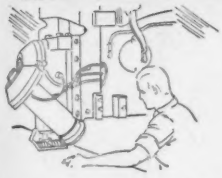
POWER—Motor develops 1.4 h.p. at 1000 p.s.i. inlet pressure. Weight of only 48 ounces and compact design eliminate needless bulk. *DAMAGE-FREE*—Stalling causes no damage to motor, permitting use of stops to eliminate flap or door overtravel. *DIRECT-REVERSIBLE*—no external bleed line required, obviating additional fittings. *ADAPTABLE*—Available with either flange or foot mounting for all installations. (Foot mounting illustrated)

Design engineers, purchasing agents, and other authorized persons are invited to consult with Clarke engineers concerning hydraulic motors and similar equipment for aircraft.

CLARKE AERO-HYDRAULICS

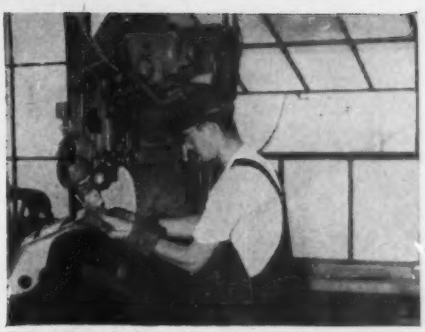
CLARKE AERO-HYDRAULICS, INC.
PASADENA · CALIFORNIA

For FAST, ACCURATE SHEARING of Thin Sheet or 1" PLATE There's a QUICKWORK ROTARY SHEAR to Handle the Job

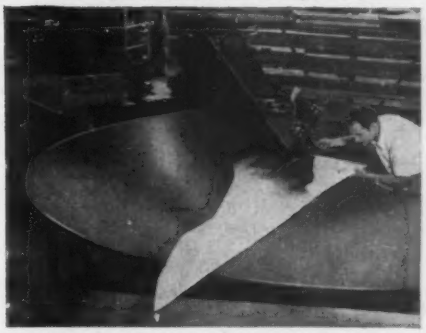


Cutting irregular contours or straight lines, openings, or narrow strips; beveling, circling, flanging, or joggling, versatile Quickwork-Whiting Rotary Shears handle all types of steel or alloy plate. They speed the Navy's shipbuilding program in many shipyards. Quickwork Shears are also on war duty in aircraft and tank factories, steel mills, and many other shops where they perform countless complicated operations accurately and at high speeds—on all types of sheet and plate up to one inch mild steel.

Don't wait for a new machine. Remember your "Quickwork" Rotary Shear. Write for information.



Trimming airplane stampings is fast, accurate, with Quickwork No. 8 Rotary Shear.



Cutting out wing section in an aircraft plant with the Quickwork.

Your "QUICKWORK" does other jobs, too

Your Quickwork Shear will also:

- Cut straight lines
- Cut narrow strips
- Cut circles
- Cut openings and irregular shapes
- Cut beveled edges
- Flange and joggle
- Make clean cuts without burrs—in a single pass at high speeds

Don't wait for a new machine. Use your Quickwork.

QUICKWORK-WHITING DIVISION

WHITING CORPORATION

15623 LATHROP AVENUE, HARVEY, ILL.

The Aviation Industry Is Served by Whiting Corporation with Cranes • Machines • and Matched Maintenance and Handling Equipment

AMERICA'S RADIAL AIR-COOLED DIESEL ENGINE

The complete elimination of the fire hazard from the power plants of America's planes will make the day of family aviation—the day when Mother and Dad or Bill and his girl friend take to the airways for business and pleasure—closer than ever before. *Family* flying must be *safe* flying and *safe* flying must be *fire-safe!* The Guiberson, using fuel that will not burn even when exposed to flame, eliminates the fire-hazard from the power plants of planes, of tanks, of light ships. Weighing approximately 2 lbs. per horsepower, the Guiberson air-cooled radial diesel is America's *safest dependable* power for high-speed transportation. Today Guiberson powered equipment is hitting the Axis on the battle lines of the world and is ready to serve American industry on land, on sea and in the air.

SAFE THAN SORRY · GUIBERSON · BETTER BE
Established 1919

- ★ *No Fire Hazard*
- ★ *Lower Fuel Consumption*
- ★ *Increased Striking Range*
- ★ *Greater Stamina*
- ★ *Dependable Operation*
- ★ *Instant Response to the Throttle*
- ★ *No Ignition System*
- ★ *Lower Cost of Fuel*
- ★ *Constant Torque at All Speeds*
- ★ *No Radio Interference*

Guiberson U.S.A.

The **GUIBERSON CORPORATION**
Aircraft and Heater Division
The **GUIBERSON DIESEL ENGINE COMPANY**
Dallas, Texas Chicago, Illinois

BALDOR
BALL BEARING GRINDERS

BALDOR Pedestal Grinder No. 121; 2 HP ball-bearing motor, 1725 rpm; complete with 12" x 12 x 2 wheels and starter $205.60

BALDOR ELECTRIC COMPANY
4380 Duncan Ave. ST. LOUIS, MO.

Manufacturers of
Electric Motors
Electric Motor Grinders
Battery Chargers
Fast Battery Chargers
Battery Testers
Write for Bulletins

"Oomph"

Precision-ize Pencil Drawings
Eliminate Inking
Relieve Draftsmen Shortage
Speed Production Time
Cut Operating Costs
Renew Old Boards

Cover any board with most perfect drawing surface yet conceived, the No-Ink Drawing Board Top. Makes discarded, worn or good boards work better than new,—new boards more efficient. Attach in 10 minutes. Costs little. Oomphs drafting speed, economy. No ink, no manila, no thumb-tacks. Used in thousands of plants. For details write

A LONG PRODUCT EST. 1911

W. H. LONG CO., 425 N. CLARK ST., CHICAGO

AMERICA'S FIGHTING PLANES IN ACTION, by Reed Kinert. The MacMillan Co., New York. 144 *pages, illustrations, index,* $2.50.

Amid his duties as a primary instructor, Artist Kinert has found time, both with his brush and typewriter to picture and describe our fighting, transport, and training planes, and blimps. He has detailed power, speeds, armament, and records of some 68 of them on single pages facing illustrations, many of them in color. His book is a fund of plane information compiled for quick reference.

AIRCRAFT MATHEMATICS, by S. A. Walling and J. C. Hill. Revised edition, The MacMillan Co., New York. 186 *pages,* $1.75.

With brush-ups on fractions, decimals, percentages, and ratios, this book leads the prospective pilot into practical problems on graphs, plane geometry, and trigonometry. It provides preparation for avigational mathematics.

FLYING MEN AND MEDICINE, by E. Osmun Barr. Funk & Wagnalls Co., New York. 254 *pages, index,* $2.50.

Believing that "a general education in the essentials of aviation medicine must be a part of the pilot's curriculum just as much as mechanics, physics, meteorology, and other flying subjects," Dr. Barr, surgeon and former pilot, presents brief, non-technical descriptions of the functions and aerial reactions of the flyer's principal vital organs and his respiratory, digestive, and circulatory systems.

STUDENT PILOT HANDBOOK, by Jack Hunt and Ray Fahringer. Books, Inc., New York, 251 *pages, illustrated,* $2.50.

In this work, fundamentals of flying are pointedly explained "to help the student pilot see more clearly the things discussed in detail in the training manuals furnished by the government agencies."

BASIC PROBLEMS IN ENGINEERING DRAWING, by William Wirt Turner. Ronald Press Co., New York. $1.25.

Provided here are 42 loose-leaf work sheets on basic first-year instruction designed to supplement standard engineering drawing texts with conformation to recommendations of the American Standards Assn.

AIRCRAFT ELECTRICAL SYSTEMS, by William F. Jorch. The Ronald Press Co., New York. 208 *pages, illustratinos diagrams, index,* $3.

Practical facts on construction, operation, and maintenance of electrical equipment, simply written for students.

LIGHT FROM FLOORS speeds war production

DARK FLOORS waste light by absorbing it. White cement floors save light by reflecting it. The advantages of making giant reflectors of your factory floors are shown by installations at Boeing, Consolidated, Douglas and North American Aircraft plants. In the Consolidated plant at Fort Worth, tests by General Electric show that the white cement floor which adjoins a gray cement floor in the same plant reflects 61% more light to under side of wings and 20% more light to vertical work surfaces.

Light-reflecting floors made with Atlas White cement have many other advantages. They encourage cleanliness, are easy to maintain, reduce disturbing shadows, give workers better and more comfortable light, improve morale, increase production, and reduce accidents, errors and spoilage.

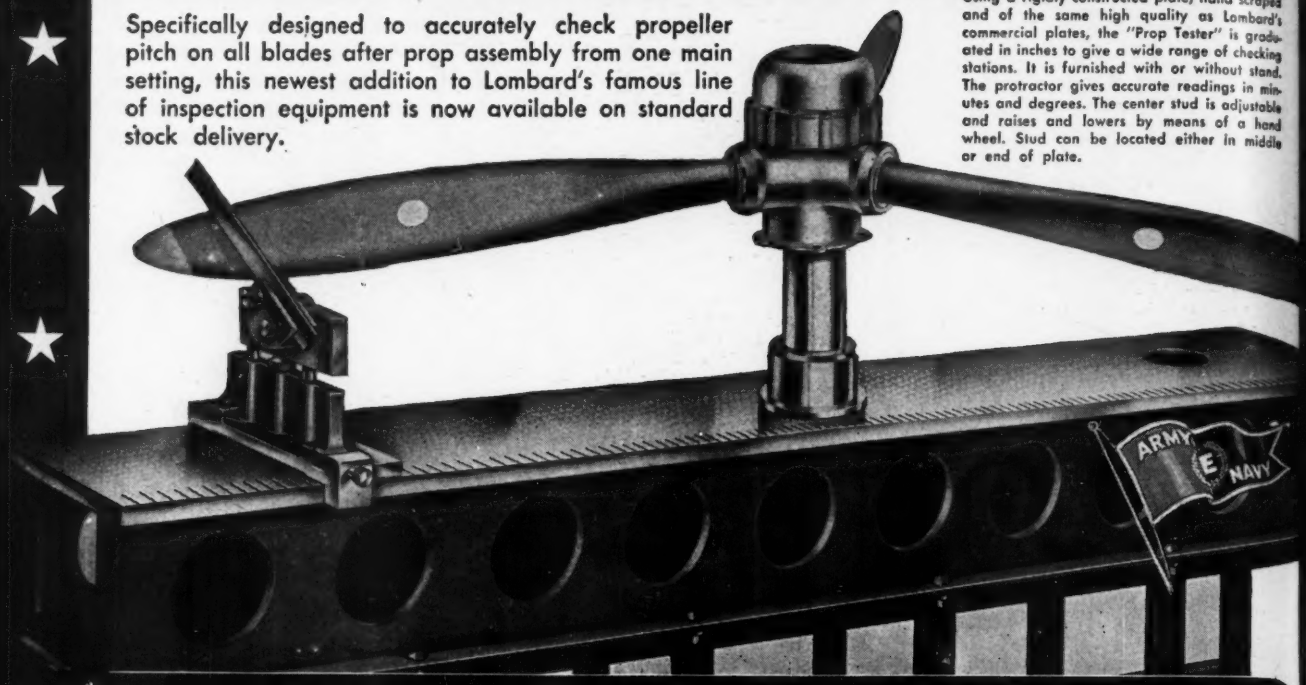
Send for new book, "Light From Floors." It tells the complete story of light-reflecting floors made with Atlas White cement. Write today. Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, New York City.
Av-F-20

ATLAS WHITE CEMENT
For Light-Reflecting Floors

LOMBARD Propeller Protractor and Checking Plate

Specifically designed to accurately check propeller pitch on all blades after prop assembly from one main setting, this newest addition to Lombard's famous line of inspection equipment is now available on standard stock delivery.

Using a rigidly constructed plate, hand scraped and of the same high quality as Lombard's commercial plates, the "Prop Tester" is graduated in inches to give a wide range of checking stations. It is furnished with or without stand. The protractor gives accurate readings in minutes and degrees. The center stud is adjustable and raises and lowers by means of a hand wheel. Stud can be located either in middle or end of plate.



LOMBARD GOVERNOR CORPORATION
650 MAIN ST., ASHLAND, MASS., U. S. A.

DANLY *Knurled*

SOCKET-HEAD CAP SCREWS
HOLLOW SET SCREWS

All Die Makers' Supplies
Danly Commercial Sets
Danly Special Sets

DANLY MACHINE SPECIALTIES, INC.
2100 South 52nd Avenue, Chicago, Illinois
MILWAUKEE • LONG ISLAND CITY, N. Y.
DAYTON • DETROIT • ROCHESTER
CLEVELAND • PHILADELPHIA
DUCOMMUN METALS & SUPPLY CO.
Los Angeles • San Francisco

DANLY
PRECISION DIE
SETS

What Makes a Mailing Click?

Advertising men agree . . . the list is more than half the story. McGraw-Hill Mailing Lists, used by leading manufacturers and industrial service organizations, direct your advertising and sales promotional efforts to key purchasing power.

In view of present day difficulties in maintaining your own mailing lists, this efficient personalized service is particularly important in securing the comprehensive market coverage you need and want. Investigate today.

McGraw-Hill Publishing Co., Inc.
DIRECT MAIL DIVISION
330 West 42nd St., New York, N. Y.

BEALL
genuine KANT-LINK
Spring WASHERS

KEEP
BOLTED ASSEMBLIES
permanently TIGHT

BEALL Spring Washers compensate for wear, bolt-stretch, corrosion and breakdown of finish. They meet rigid Army, Navy and Air Corps specifications. Available in Carbon Steel, Stainless Steel, Phosphor Bronze, Everdur and Monel Metal. Finished in Cadmium Plate, Galvanized, Silver and Parkerized. IMMEDIATE SHIPMENT of all standard sizes.

WIRE US your requirements
BEALL TOOL COMPANY
Div. Hubbard & Company
EAST ALTON, ILLINOIS